THE
BRITISH JOURNAL OF SURGERY

VOL. XXV OCTOBER, 1937 No. 98

ON GALL-STONES AND THEIR SUFFERERS

BY GORDON GORDON-TAYLOR, LONDON

ALTHOUGH the destiny of an empire or a people may have been at times profoundly altered by the death of a king, an emperor, or a ruler, only on occasion has pathology by undermining the powers and sway of individual leadership transformed the palimpsests of history. Leaders of men and heroes from Agamemnon down the ages, " the captains and the kings ", have too frequently been struck down by the clenched fist of Fate before bodily degeneration and decay could warp their judgement, undermine their sway, or subvert their guidance of a people or a race; yet one may learn from the perusal of, for example, Henry Wade's convincing essay on the " Unbalanced Urinary System "[1] how mental disturbances engendered by this derangement in Napoleon led to that fatal indecision which rendered the Battle of Borodino a mere Pyrrhic victory. The fatal morning of September 7 proved not only the turning-point of the Russian Campaign of 1812, but perhaps of the Emperor's meteoric career.

The truly great personages and mighty potentates of the world have most often died prematurely in the heat of battle, through the guile of the poisoner, from the bullet of the assassin, by the knife, axe, rope, or cross of the executioner, so that pathology, unless inherited or of infective nature, has had too little time wherewith to warp diplomacy or render jejune the former perchance mighty policy of a race or state.

Yet Death himself has not always succeeded in imposing his final decree upon the human thrust, for some leaders of men have been mighty enough after their demise, even in the very manner of their end, to influence their subordinates, their descendants, followers, or devotees; the teaching and example of Christ and the memory of the Mussulman prophet of Allah are perpetuated in the name of that particular faith which binds millions of men and women together. Even the tangible corporeal remains of prophets and kings are known to have been invested with a reputed power to influence in greater or less degree the march of history, for the bones of Joseph accompanied the Israelites in their wanderings out of Egypt into Palestine, and those of the Grecian Orestes brought fortune to Sparta.

I am unaware, however, of any prophet, priest, or king, authentic or legendary, whose death from gall-stones may have frayed or disrupted the riband of history, save possibly Alexander the Great (*Fig.* 176). Certain monarchs have indeed suffered from cholelithiasis, and objective evidence of this statement has been

furnished at autopsy, but their actual death has been due to some concomitant pathology; thus James VI of Scotland and I of England had jaundice, but was afflicted with many other maladies, and although Catherine the Great of Russia was found after death to have calculi in her gall-bladder, she perished from a 'stroke' that, with poetic justice, seized her seated on the commode which before conversion to a utilitarian purpose had been itself the actual throne of the Kingdom of Poland!

In the case of Alexander the Great, the diagnosis of gall-stones, or at least of cholecystitis, rests on no post-mortem examination; yet there is much in his mode of life and in the record of his final illness that is consistent with such a diagnosis. It is related that on June 1, 323 B.C., he gave a private dinner to his Admiral Nearchos and his chief officers; the festivities were carried on till a late hour. From this feast he went to the house of a Thessalian called Medios, where the carousal continued until dawn of June 2. After spending the day in heavy sleep he again repaired to the house of his host of the preceding night and once more made merry until morning. During the night he toasted each of the twenty guests, draining a large goblet of wine in honour of every man; he afterwards complained of *a stabbing pain in the back, and felt feverish and sick.* Despite this, on the morning of June 3 he was able to have a bath, to partake of a little food, and to make his accustomed morning sacrifice at sunrise. He lingered on until June 13, racked with fever and growing weaker and weaker; and at the end he was hardly conscious.

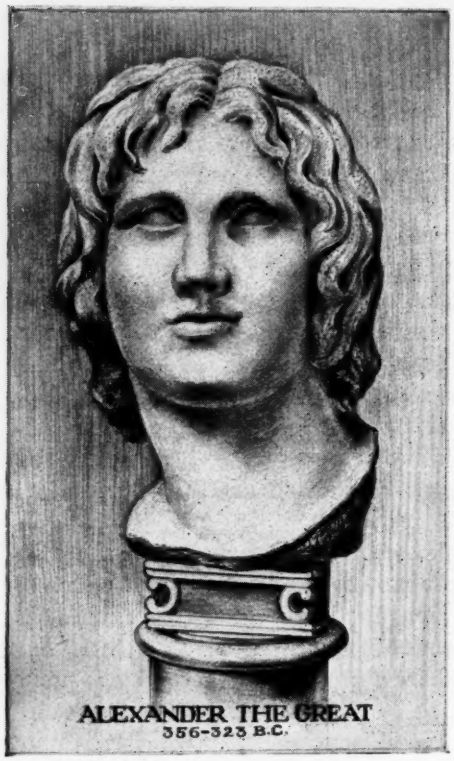


FIG. 176.—Alexander the Great.

It would appear on the authority of Athenaeus that Alexander was assuredly a gourmet; for example, there is recorded in *The Deipnosophistae* the appointment of Ptolemy as 'eater' or 'foretaster' to his household. Regarding the drinking propensities of the great leader, it is averred that he drank a great deal, so that after a debauch he would sleep continuously for two days and nights (!), and Menander writes that "to drink like Alexander" was a by-word for exaggerated conviviality; and that author also alludes to a man who, on a certain occasion, "performed the wonderful feat of drinking more" than this son of Zeus-Ammon.

When the great leader entertained his friends he was wont to spend 100 minæ on a dinner for 60 to 70 guests, a sum amounting to roughly £5 10s. 0d. per head, and at these banquets the figs, raisins, and nuts were encased in gold![2] Chares of Mitylene in his *Records of Alexander*, when recounting the story of the Indian expedition, describes the 30 refrigerating pits for the wine, which Alexander filled

with snow and oak boughs, remarking that in this way the snow would last a longer time; the suggestion, if not indicative of the gourmet, at least denotes the good quartermaster-general! Hard work and hard-living marked him out for an infection of his biliary tract!

It is but fair to add that Plutarch makes a point of denying the existence of pain in the back; "nor was he taken with any sudden pain in his back as if he had been struck with a lance, for these are the inventions of some authors who thought it their duty to make the last scene of so great an action as moving as they could". The constant mention of temperature has prompted an alternative diagnosis that the fatal malady was a severe malaria (Weigall).[3]

Somewhere the suggestion has been proffered that he died of dysentery, and the assertion made that he reached Babylon exhausted by dysentery after rashly, vaingloriously leading his troops and followers across the Gedrosian Desert, that his temperature at once rose, and that in a few days he was dead. Alexander, however, crossed the Gedrosian Desert in that sixty days' march during October and November of 325 B.C. nearly two years before his demise, and during the whole of 324 and the early part of 323 his time was fully occupied in arranging the disposition of his Court at Susa, in settling a mutiny of his Macedonian troops at Opis, some fifty miles north of Baghdad, and in countless other schemes. He made tours of inspection of the canals and lakes at the mouth of the Euphrates, prepared for the colonization of the whole of the Persian Coast from the mouth of the Indus to the top of the Persian Gulf, and his unlimited activities betoken no evidence of a zeal flagging through dysentery; indeed such was his exuberance of spirits and his enthusiasm that although only 32 years of age he felt that in the briefest space of time he would be lord of the whole earth.

He approached Babylon in February, 323 B.C., but it was not until June that he died of a brief illness. The death of his beloved friend Hephastion reduced him to a woeful degree of despair, and produced in him an unreasonableness and a cruelty that crucified the unfortunate physician of his friend: thereafter he appeared to care little what became of him.

Physical and mental exhaustion were probably factors determining an acute upper abdominal lesion; one cannot, of course, dismiss from the diagnosis the possibility of a hepatic abscess consequent on dysentery, or that complication of biliary tract infection, acute pancreatitis. The jovial monk, the occupant of the local mayoralty chair, the bon-vivant are regarded us amongst those specially prone to be afflicted with this latter disease, and the prodigious drinking and feasting in which the son of Zeus-Ammon participated lend a little support to such a diagnosis.

Cholecystitis, cholelithiasis, or some complication of biliary tract pathology may have cut short the career of one of the greatest leaders of mankind, and his dreams of a world-empire with Babylon the capital of the East and Alexandria of the West were dissipated by his premature end from an abdominal crisis.

Gall-stones have been met with in ancient days as well as in modern times; they are present in the mummy priestess in the Royal College of Surgeons Collection (*Fig.* 177). The specimen is that of a mummified liver of a priestess of Amenen of the XXI Dynasty (circa 1500 B.C.); the gall-bladder is filled with small spherical calculi. The mummy came from Deir-el-Bahan, Thebes, and was presented by the late Sir Grafton Elliot-Smith in 1909.

In calculous disease of the biliary tract the wealthy may indeed be penalized, as pointed out by Wilkie, by the very reason of the time and the money that can be lavishly, if vainly, expended by them in the search for relief and in the hope of cure, by sojourn in Continental spas, or from a loyal adherence to medicines and pills, proprietary or official, and to dietaries prescribed by learned physicians or fellow-sufferers amongst the laity.

The pangs of gall-stone colic have afflicted both politician and proletariat, the Hollywood 'star' as well as those she holds in mental thraldom, the novelist and the writer of poetry; untold anguish has also been endured by physician, surgeon, general practitioner, and even by those most highly placed in our profession. I am assured on unimpeachable authority that Samuel Johnson, the great lexicographer, had gall-stones, and the story of the agonies of biliary colic from which Sir Walter Scott suffered during several of his most prolific literary years

FIG. 177.—Liver and gall-bladder containing calculi from mummy priestess in the Museum of the Royal College of Surgeons of England. (*By kind permission of the Royal College of Surgeons.*)

invests with an almost heroic splendour that room in 39, Castle Street, Edinburgh (*Fig.* 178), and his original library at Abbotsford, where six of the Waverley novels were written in the intervals between and even during the attacks of pain. Lord Tweedsmuir terms the years 1817–1819 "The Broken Years"[4] during which Sir Walter had to struggle against serious ill-health; but even before the end of 1816 he had experienced attacks of "vile spasm" which he had combated by drinking hot water, and doubtless *Old Mortality* was conceived and born when Scott was beginning to suffer from the inaugural symptoms of that malady which was to beset him during the next three years.

By March 1, 1817, he found himself constrained to address a note to Dr. Matthew Baillie[5] under cover of a letter to his sister, Joanna Baillie, regarding "a very violent and acute complaint, the cramp in my stomach, with which I have been assailed three or four times this season with greatest possible violence. Last night* the agony was so great that I fainted, which was a novelty to me," and

* Feb. 28, 1817.

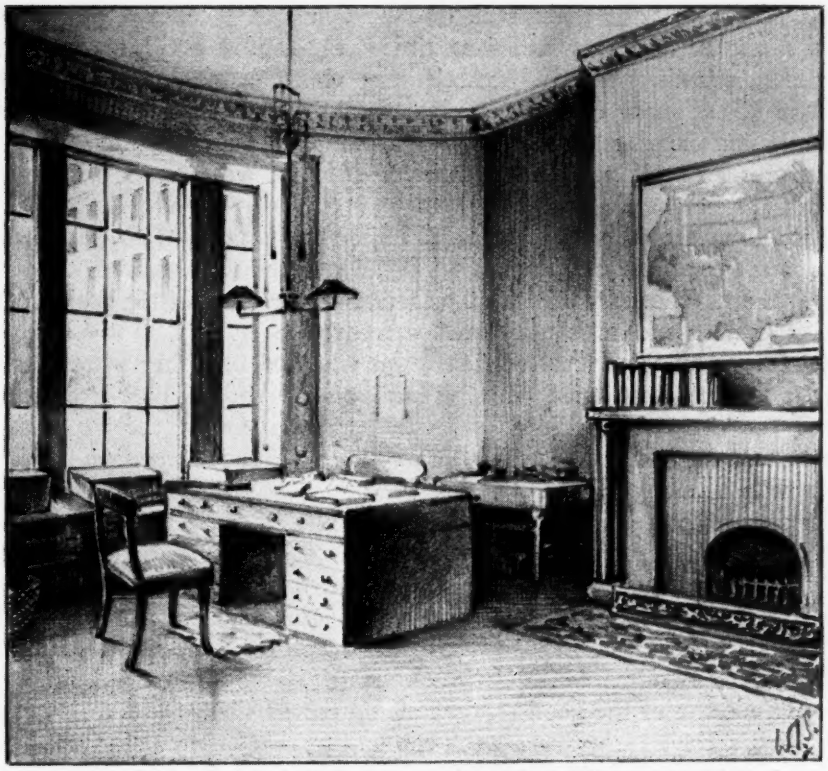


FIG. 178.—Sir Walter Scott's room at 39, Castle Street, Edinburgh, where he sat and worked despite grave illness—usually in the corner of the room next the window.

FIG. 179.—The front of 39, Castle Street, the house where Sir Walter Scott had the attack of biliary colic at the dinner-party, March 5, 1817; the window of the dining-room is opposite the lamp-post on the left.

Scott thought that " the grim skeleton was going to take my harp out of the Minstrel's hands." Before sufficient time had elapsed for him to receive an answer from Matthew Baillie, another very violent attack of pain seized him and broke up a small dinner party at his Edinburgh home, 39, Castle Street (*Fig.* 179), and he " retired from the room with a scream of agony which electrified his guests " and tells us himself that he went to bed " roaring like a bull-calf ".

Throughout the year 1817 attacks of biliary colic assailed him, recurring every three or four weeks ; in the later period of the year the seizures were never characterized by the violence exhibited by the agonizing " cramp " of the spring, although he did experience one of severity in November.

On the whole, the next year, 1818, was a period of rather better health and his letters are less concerned with his own body ; they bubble over with such topics as the excitement aroused over the disinterment of the Scottish regalia " sleeping beneath the dust that had been gathering round them since the Union ", and also with accounts of the building operations at Abbotsford.

The attacks, however, did not altogether cease to torment him, and he wrote that sitting at his desk hurt him and that " cold or fatigue of any kind almost certainly brings on the unlucky cramp in the stomach, and I am obliged to limit my walks and attend to weather circumstances quite new to one whose pleasure lies chiefly in the open air ". Towards the end of 1818 we read " cramp haunts my couch like a nightmare ".

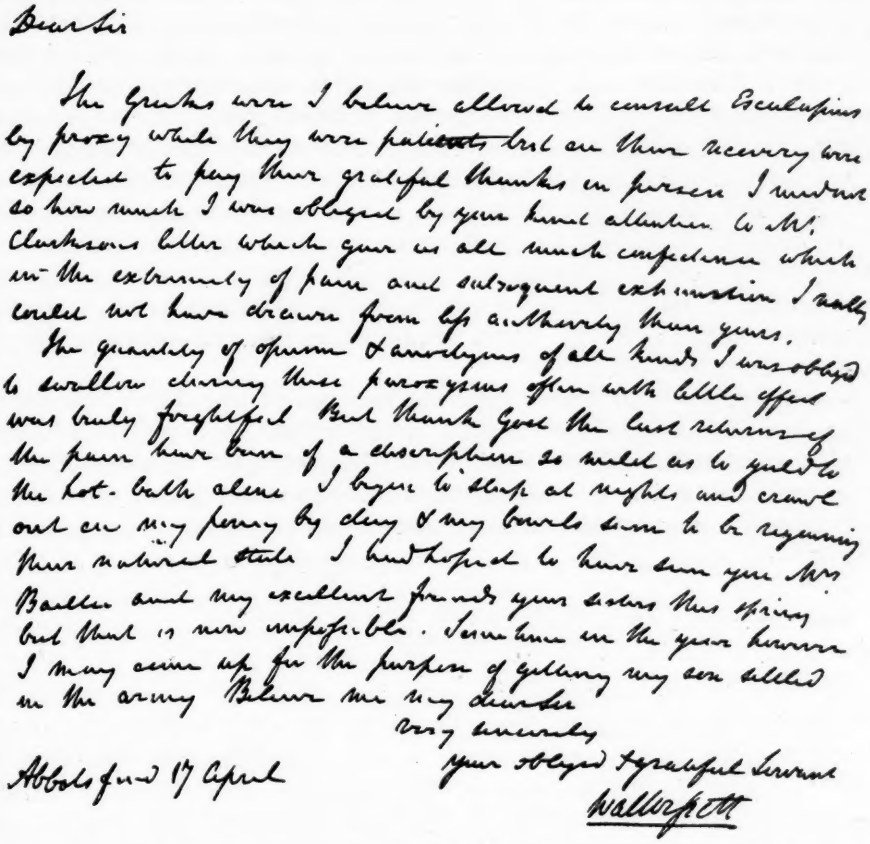
Not unmindful of the good services of Matthew Baillie, Scott writes to Joanna on New Year's Day, 1819, that a week ago he had sent off by boat from Inverness ten brace of ptarmigan from Glen Affric, and expressing the hope that the present would not miscarry since it was simply addressed to " Dr. Baillie, London " !

He soon began to have renewed visitations of his old complaint, and on March 14 he mentions the presence of " a most brilliant jaundice ", and a month later writing from Abbotsford he says " when I crawl out on Sybil Grey I am the very image of Death on the pale horse, lanthorn-jawed, decayed in flesh, stooping as if I mean to eat the pony's ears ". In April was written the appended letter (*Fig.* 180) to Matthew Baillie which is in the Scott-Baillie Collection belonging to the Royal College of Surgeons of England ; in Baillie's diagnosis* and advice Scott had reposed a great confidence, and was evidently greatly fortified by that physician's assurances that his malady was not a fatal one ! To Daniel Terry the actor he writes at the same time that he had taken in the space of six or seven hours 6 grains of opium, 3 grains of hyoscyamus, and nearly 200 drops of laudanum, " and all without any sensible relief of the agony under which I laboured ".

Despite his trust and hope that now all would be well, in May his illness was of such severity that he himself thought he would not survive long, and during another attack in June lasting eight days it appeared as if the end had actually come. In the same month he began to extol the merits of another physician, a retired East India Company doctor ; it is perhaps churlish to ascribe the subsequent freedom from all symptoms relating to his biliary tract to a ' natural cure ', and not to those prescriptions of calomel in small alternative doses which was the

*Baillie had already made the diagnosis of gall-stones.

new line of treatment advised. On June 15, 1819, he writes to Daniel Terry: "A very intelligent man, Dr. Dick, late physician to the East India Company, has put me on a very simple regimen by which I am already so very much benefited, that I doubt not by perseverance I shall be cured completely. Calomel, not used in doses which I had already employed, but in such very small quantities and so constantly as to maintain the effect of the mineral on the constitution, but not to bring on salivation is, Lord love its heart, an absolute specific. Ten days' rigid attention to his directions has restored me to action and to appetite and to healthy digestion."



Dear Sir

The Greeks were I believe allowed to consult Esculapius by proxy while they were patients but on their recovery were expected to pay their grateful thanks in person I mention so much I was obliged by your kind attention to Mr. Clarkson's letter which gave us all much confidence which in the extremity of pain and subsequent exhaustion I really could not have drawn from life as I thereby have yours.

The quantity of opium & anodynes of all kinds I was obliged to swallow during those paroxysms often with little effect was truly frightful But thank God the last returning the pain have been of a description so mild as to yield to the hot bath alone I began to sleep at nights and crawl out on my pony by day & my bowels seem to be regaining their natural state I had hoped to have seen you Mrs Baillie and my excellent friends your sisters this spring but that is now impossible. Some time in the year however I may come up for the purpose of getting my son called in the army Believe me my dear Sir

very sincerely

Abbotsford 17 April

your obliged & grateful Servant

Walter Scott

FIG. 180.—Letter from Sir Walter Scott to Sir Matthew Baillie, from the Scott-Baillie Collection of Letters, Royal College of Surgeons. (*By kind permission of the Royal College of Surgeons.*)

Yet despite his suffering during these years 1817 to 1819 Scott planned and wrote the following famous novels: *Rob Roy*, *The Heart of Midlothian*, *The Legend of Montrose*, *The Bride of Lammermoor*, and *Ivanhoe*. But even this amount did not complete his tale of literary activities, for he also wrote *Harold the Dauntless*, *Border Antiquities*, and a long burden of "history for the *Annual Register*"; there was also a play *The Doom of Devorgoil* which in fact was not published until 1830 and was never produced on the stage, and many contributions to *Blackwood's Magazine* and the *Quarterly Review*.

Few works of any kind have been produced under such severe physical pain as that which racked Sir Walter Scott when he wrote *The Bride of Lammermoor*: this novel and *Ivanhoe* were created under spasms of pain so severe that Hogg declared he had seen Scott's shirt "burned to an izel*" by hot fomentations. His huge wolf-hound, Maida, comforted him with his unspoken sympathy, and half-drugged, half-comatose, Scott completed *The Bride of Lammermoor*, the most pure and powerful tragedy of his whole repertory; he had written it from first to last under the fumes of "that accursed laudanum" which he had subsequently to exorcize by moorland rides under the shadow of Eildon well on into 1820. When the printed story was placed in his hands by James Ballantyne, Scott failed to recognize the characters that his own genius had portrayed. It is not the less remarkable that this novel is regarded by many as perhaps the finest of his masterpieces; thus Tennyson and Gladstone placed it æsthetically first among the Waverleys: Jowett is said to have re-read it every two years.[6] *The Bride of Lammermoor* is the one novel written during these years of bodily anguish which betrays any sign of the mental and physical torment through which he was passing; Buchan points out that it was the product of a drugged and abnormal condition, even as Coleridge composed *Kubla Khan* in an opiate dream! Perhaps it was this toxic mental state that reawakened memories of his own first love long-days ago and translated the figures concerned in that personal tragedy of his own into the characters of Lady Ashton, Lucy, the Lord Keeper, and others in *The Bride of Lammermoor*.[7]

Still another poet may have suffered from gall-stones, for it is more than probable that Horace had cholecystitis; he describes such an attack following a dietetic indiscretion. In the third *Epode* he attributes his discomforts to a meal of garlic of which he had partaken in Maecenas' house, but doubtless this may have been merely the particular article of food to which he himself ascribes the blame:—

> Nec munus humeris efficacis Herculis
> Inarsit aestuosius.† [8]

Evidently the pain was located in the shoulder region. In respect of the usage of "(h)umeris" in the passage from this *Epode*, this term is frequently used for the shoulder region, and in any event the word is found far more frequently than the term 'scapulæ' in the literature of the Republican and Augustan period. I am informed by several medical friends who have gall-stones that garlic or onions often occasion discomfort in the gall-bladder region. As regards his habits, Horace was undoubtedly a connoisseur of good food and wine; a perusal of those verses culled from his works which accompanied the various courses at the Bi-millenary Celebration Dinner of the Horatian Society in 1935 confirms this predilection for good food and wine; such habits predispose to cholecystitis. Further, Suetonius tells us that he was "brevis atque obesus",‡ and quotes a joke of Augustus on the matter "Vereri autem mihi videris ne maiores libelli tui sint, quam ipse es;

---

* A cinder.

† 'Nor did Nessus' gift burn with fiercer flame into the shoulder of Hercules.'

‡ 'Short and fat.'

sed tibi statura deest, corpusculum non deest"[9]* Horace writes of himself:—

> Me pinguem et nitidum bene curata cute vises,
> Cum ridere voles, Epicuri de grege porcum.† [10]

The representation of Horace here shown (*Fig.* 181) is on a contorniate (i.e., a piece with turned-up edge), probably of late 4th or 5th century A.D.; it is not a coin, but was perhaps used in some kind of game associated with the circus and the public shows. By my old friend, W. Blair Anderson, now Kennedy Professor of Latin at Cambridge University, and Mr. Mattingly, Department of Coins and Medals, British Museum, I am informed that there seems to be reasonable probability that the portrait of Horace is a traditional one, going back to contemporary or almost contemporary models. The little badge at the top of the note-paper of the Horatian Society is a reproduction of this contorniate, and Viscount Hereford, Mr. S. A. Courtauld, and other officials of the Society are in agreement in thinking that this is more likely to resemble the poet than is Mr. Courtauld's bust of Horace which was bought some thirty years ago by that generous benefactor of Middlesex Hospital and exhibited at the 1935 Bi-millenary Dinner held in the Cordwainers' Hall, London.

FIG. 181. — Contorniate exhibiting bust of Quintus Horatius Flaccus (65–8 B.C.), from the Coins and Medals Department, British Museum.

Surgeons themselves are not immune from gall-stones; among the mighty, John Hunter was found to have both coronary thrombosis and gall-stones; and in more recent times Sir Frederick Treves died abroad, unoperated, of a perforated gall-bladder and peritonitis. At least two former Presidents of the College of Surgeons have had gall-stones or disease of the bile-passages; the dictates of good taste forbid the mention of their names and those of others, many of them friends, preserved by operation directed towards their biliary tract, whereby they find themselves still empowered to advance not only the science but also the art of surgery.

LONGEVITY AND GALL-STONES

Let us descend from 'stardom'! Patients who have suffered from infection or from some disturbance of metabolism are hardly likely to become centenarians; but I have known two gall-stone patients, of whom one reached the age of 93 without operation; the other was operated upon by me for calculous cholecystitis and cholangitis at the age of 84 years, and died in her ninety-ninth year, apparently of a cerebral hæmorrhage. The first patient, a very near relative, had recurrent attacks of biliary colic for many years; her symptoms and clinical signs,

---

* 'You seem to be afraid lest your books are larger than you are yourself; but if height is denied you, your body is certainly not lacking'.

† 'As for me, when you want a laugh, you will find me in fine fettle, a hog from Epicurus' herd'.

which included jaundice, were always regarded as characteristic of cholelithiasis. Almost the whole of her life was spent in Germany; when she was over 90 years of age a cholecystogram was done, and the gall-bladder failed to exhibit any shadow with the dye. The attacks had been severe in her late years, and she may have undergone a natural cure.

The second patient, who just failed, to my intense disappointment, to attain the age of five score years, underwent a choledochotomy and cholecystectomy fourteen years before her demise; in addition to her calculous common duct she had a suppurative cholecystitis. She had no further return of abdominal pain, and died quite suddenly in full possession of all her faculties at the age of 98 years and 6 months.

THE GALL-BLADDER AND WAR-SURGERY

Two 'unknown soldiers' were operated upon by me in the early months of 1918 in the forward area near St. Quentin. One required surgical treatment for acute calculous cholecystitis in a Casualty Clearing Station on the Fifth Army Front during the relatively tranquil days which preceded the German onslaught of March 21; warrior-like, he was found to have a gumma of his liver as well! A good recovery followed operation and the man was evacuated to the Base. A still more curious freak of fortune befell the other patient; he received a right-sided abdomino-thoracic wound, the fragment of shell rupturing his gall-bladder and leading to an extravasation into the peritoneum of bile and the gall-stones which the viscus had contained. Unknown to me in name, unknown is also his fate; he was last seen lying on the 'duckboards' before being tenderly placed in an open truck on an empty ammunition train which had been commandeered to evacuate the wounded from the Clearing Station, when the advancing Germans were a disagreeably short distance away.

The story of this case with doubtful fate, where gall-bladder, gall-stones, and bile were scattered over the abdominal cavity, calls to mind those lines in the *Antigone* of Sophocles, where the seer Teiresias tells Creon that the portent was doubtful, since the sacrificial offering would not burn and the gall-bladder and the gall of the victim were "scattered to the air".

The French have a proverb "un peu de fiel gâte beaucoup de miel"; and it may be judged by those desirous of reading the other pages of this number of the BRITISH JOURNAL OF SURGERY that enough has already been written on such as have endured the bitterness of disease of the gall-bladder and the gall.

I should be greatly wanting in gratitude did I fail to express my indebtedness to many friends, especially Sir D'Arcy Power, Professor W. Blair Anderson of Cambridge, and Mr. W. R. LeFanu, Librarian at the Royal College of Surgeons. To the Council of the College of Surgeons I am most greatly obliged for permission to reproduce the liver and gall-bladder of the mummy-priestess depicted in *Fig.* 177, and also the letter of Sir Walter Scott to Dr. Matthew Baillie. The officials of the British Museum have been lavish in their courtesy. The information culled from Buchan's *Sir Walter Scott* and from the essays of Thomas Seccombe in the *Scott Centenary Articles* has been invaluable, and it is with a special pleasure that I have perused those *Letters of Sir Walter Scott* written in the years 1817 to 1819

and edited by my former teacher, Sir Herbert Grierson, Regius Professor of English Literature at the University of Edinburgh and formerly at the University of Aberdeen.

REFERENCES

[1] WADE, HENRY, "Unbalanced Urinary System", *Jour. of Urol.*, 1932, xxviii, No. 4, October.
[2] ATHENAEUS, *Deipnosophistae*, iv, 146.
[3] WEIGALL, ARTHUR, *Alexander the Great*, 1933. Thornton Butterworth & Co.
[4] BUCHAN, JOHN, *Sir Walter Scott*, 1932. Cassell & Co.
[5] GRIERSON, SIR HERBERT, *The Letters of Sir Walter Scott*, Centenary Edition, iv and v.
[6] SECCOMBE, THOMAS, *Scott Centenary Articles*, 1932, Oxford University Press.
[7] GRIERSON, SIR HERBERT, *Blackwood's Magazine*, 1931, February, 168 et seq.
[8] HORACE, *Epodes*, iii, 17, 18.
[9] SUETONIUS, quoted by Middleton and Mills, *Companion to Latin Authors*, 1876, 169, 170. McMillan & Co.
[10] HORACE, *Epist.*, i, 4.
[11] SOPHOCLES, *Antigone*, l. 1010.

THE MOVEMENTS OF THE SHOULDER-JOINT

A PLEA FOR THE USE OF THE 'PLANE OF THE SCAPULA' AS THE PLANE OF REFERENCE FOR MOVEMENTS OCCURRING AT THE HUMERO-SCAPULAR JOINT

By T. B. JOHNSTON

PROFESSOR OF ANATOMY, GUY'S HOSPITAL MEDICAL SCHOOL

In a contribution to this JOURNAL in 1932, C. P. Martin[1] drew attention to two very important points in connection with the movements at the shoulder. He demonstrated that whether the arm be elevated to the vertical in the sagittal or in the coronal or in any other plane, the end-result is always the same, namely, that the medial epicondyle points forwards and somewhat medially. Secondly, he drew attention to the fact that when the arm is elevated to the vertical in the coronal plane, it undergoes an appreciable degree of lateral rotation during the process.

Codman[2] has drawn attention to the same two points, and in addition has shown that when the arm is elevated to the vertical in the sagittal plane, it undergoes an appreciable and demonstrable degree of medial rotation in the process; and more recently Lee MacGregor[3] has stressed the same points in this JOURNAL.

These observations are of considerable importance and can readily be confirmed, but none of the authors referred to has offered a convincing explanation for the rotation which occurs. The problem is complicated by the observations of Cathcart,[4] recently amplified by the work of Lockhart,[5] that when the arm is raised to the vertical, the sterno-clavicular, acromio-clavicular, and humero-scapular joints are all moving simultaneously throughout the movement. The fact that the movements are occurring simultaneously at all three joints, however, does not negative the possibility of analysing them into their three components, and the object of this communication is to analyse the movements occurring at the humero-scapular joint with a view to obtaining a satisfactory explanation of the rotation noted by Martin and Codman during elevation of the humerus.

According to Fick[6] the head of the humerus, which faces upwards, backwards, and medially in the resting position, is inclined backwards at an angle of 30° to the coronal plane, and lies in what he terms the "Nullmeridianebene" or "dead meridian plane", which, he says, is for all practical purposes the "Schulterblatterebene" or "plane of the scapula".* In this position the vertical line which divides the articular head of the humerus into approximately equal anterior and posterior halves is opposed to the corresponding vertical diameter of the glenoid cavity. This may or may not be exactly accurate, but for all practical purposes it may be regarded as such, and will be so regarded in the argument that follows. In case, however, it should be urged that Fick's estimate of the position of the

* The 'plane of the scapula' is not easy to define, but it may be regarded as a plane drawn at right angles to the glenoid cavity through its greatest vertical diameter.

humeral head relative to the scapula is inaccurate and the argument therefore invalidated, the effect of such a deviation from the plane of the shoulder-blade will be considered later.

Many writers, including those already quoted, have deplored the confusion arising in connection with the terms applied to the movements at the shoulder, and incidentally they have not lessened the existing confusion by the introduction of a number of new terms. The confusion is attributable in part to the increased range of the arm movements owing to the mobility of the scapula and clavicle, but it is also attributable, I believe, to a failure on the part of many writers to appreciate the importance of referring the movements of the humerus in flexion and extension, abduction and adduction, to the plane of the scapula.

Most English anatomists and clinicians in using the term 'flexion of the humerus' imply movement forwards in a sagittal or paramedian plane, and in using the term 'abduction' imply movement away from the side of the body in the coronal plane. By so doing they relate the movements of the humerus to the trunk and not to the scapula, although in every other joint in the limbs—with the exception of the hip-joint, which presents special difficulties—the movements of the distal bone are related to the proximal bone. For example, flexion and extension of the elbow-joint are universally described as movements occurring around a more or less transverse axis passing through the lower end of the humerus, and no matter what the position of the humerus may be, movements around this axis are always regarded as movements of flexion and extension.

Thane,[7] however, described flexion of the humerus as a movement which occurs around an axis approximately perpendicular to the centre of the glenoid cavity and carries the arm forwards and medially across the front of the chest, and in the latest editions of *Gray's Anatomy* and *Cunningham's Text-book of Anatomy* the same definition is accepted. In *Gray* it is expressly stated that movements of flexion and extension of the humerus occur in a plane at right angles to the plane of the scapula. This movement is a simple one because it involves no rotation of the bone around its long axis, and it is the movement observed in the arms of most competitors in a walking-race, when, presumably, all the muscles are being used to their greatest degree of efficiency. In accordance with this definition the term 'abduction' should be restricted to movements away from the side of the body in the plane of the scapula, and, in what follows, this movement will be termed 'true abduction', and the movements in a plane at right angles to the scapular plane will be termed 'true flexion' and 'true extension'.

There are many arguments that might be advanced in favour of this view, but I shall satisfy myself here by pointing out that the method of treating shoulder injuries and deltoid paralysis in the coronal plane—now deservedly and almost universally abandoned—was founded on the teaching that abduction of the humerus occurred in a coronal plane and that the deltoid and supraspinatus were abductors in this plane. The 'aeroplane' splint, which has replaced Middeldorpf's splint and its modifications, retains the limb in the position of 'true abduction', more or less accurately, and is the best practical demonstration of the importance of the scapular plane that could possibly be obtained. The position is comfortable and can be maintained indefinitely, because the inferior part of the capsule of the shoulder-joint, though taut, is not twisted, and the fullest degree of relaxation is given to the supraspinatus and to the clavicular and acromial fibres of the deltoid.

On the other hand, the position of right-angled so-called 'abduction' cannot be maintained for any length of time even by an uninjured subject without intense discomfort, because in this position the inferior part of the capsule is not only taut but is subjected to a twisting strain (*Figs.* 182, 183), and the supraspinatus and the clavicular fibres of the deltoid are out of alinement.

It may, perhaps, be worth while at this stage to recall Duchenne's[8] teaching with reference to the actions of the deltoid and the supraspinatus. He held that the deltoid really comprised three different muscles, each capable of acting apart from the other two. The clavicular fibres draw the arm forwards and medially,

FIG. 182.—The capsular ligament of the shoulder-joint viewed from below, with the humerus in the position of full 'true abduction'. Note that the humerus lies in the plane of the scapula.

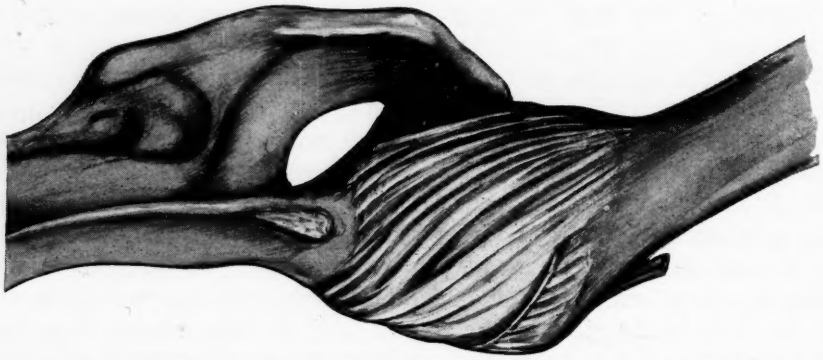


FIG. 183.—The capsular ligament of the shoulder-joint viewed from below, with the humerus fully abducted in the coronal plane. Note the twist on the fibres of the capsular ligament.

while the acromial fibres draw it laterally, and the spinal fibres draw it backwards. The spinal fibres are incapable of raising the humerus through more than 45°, and when the arm is raised to a higher level they take no active part in the process, although they no doubt contribute to the efficiency of the other parts by steadying the humerus against the glenoid cavity. When the clavicular and acromial fibres are contracting simultaneously, the arm is elevated in the plane of the scapula, and the action of the supraspinatus elevates the humerus in the same plane.

Reference has been made already to the association of the movements at the humero-scapular joint with the movements of the scapula and clavicle, and to the important influence of scapular rotation in elevation of the humerus to the vertical position. Only the most elementary knowledge of mechanics is necessary

to appreciate that the full benefit of scapular rotation can be obtained only when the humerus lies in the plane of the scapula. When the arm is placed in the position of ' true flexion ' and the movement is carried out to the limit of its range—which is a little less than 90°—no amount of scapular rotation can raise the arm any higher, so long as the humerus is retained in a plane at right angles to the scapular plane. As slight degrees of abduction are added, i.e., as the arm is swung laterally, the amount of elevation possible is steadily increased, but *it is not until the movements of the humerus and scapula bring the two bones into the same plane that the full limit of elevation can be obtained.* When the arm is raised to the vertical—no matter what plane or planes it may move through in the process—at the end of the movement the humerus must lie in the plane of the scapula. This statement may be regarded as an obvious amplification of Martin's observation that, with the arm vertical, the medial epicondyle is always directed forwards.

FIG. 184.—The resting position of the humerus relative to the scapula (Position A).

The ground having been cleared by these preliminary observations, it is now possible to make an attempt to explain the phenomena recorded by Martin, Codman, and Lee MacGregor. From the facts which they have established, namely, that when the arm is raised to the vertical in the coronal plane it is rotated laterally in the process, and when it is raised to the vertical in the sagittal plane it is rotated medially in the process, one might have inferred that somewhere between those two planes there is a plane in which elevation of the humerus to the vertical can be carried out without any rotation of the bone around its own long axis. Experiment will show that that inference is substantially correct, for when the humerus is elevated in the plane of the scapula (' true abduction '), it can be carried to the vertical without being rotated any more than can be accounted for by the alteration which the plane of the scapula undergoes as that bone swings forwards and upwards round the chest wall (for it must be remembered that any such alteration will cause an apparent rotation of the humerus around its long axis).

It would appear, therefore, that the humerus can be elevated through 180° without being rotated, or the movement may be accompanied by lateral rotation, or by medial rotation, according to the plane chosen, and Martin has shown that the end-result is the same in each case! These observations are, at first sight, mutually contradictory, and Codman has gone so far as to enunciate the paradox: " You can *prove* that the completely elevated arm is in either extreme external rotation or in extreme internal rotation ". This paradox, however, cannot be accepted, and the proof which the author advances in support of it will be

considered later. Nevertheless, the accepted facts are all susceptible of proof, and they must therefore be capable of being harmonized, and they are capable of being harmonized without recourse to X-ray cinematography or any other expensive method of research.

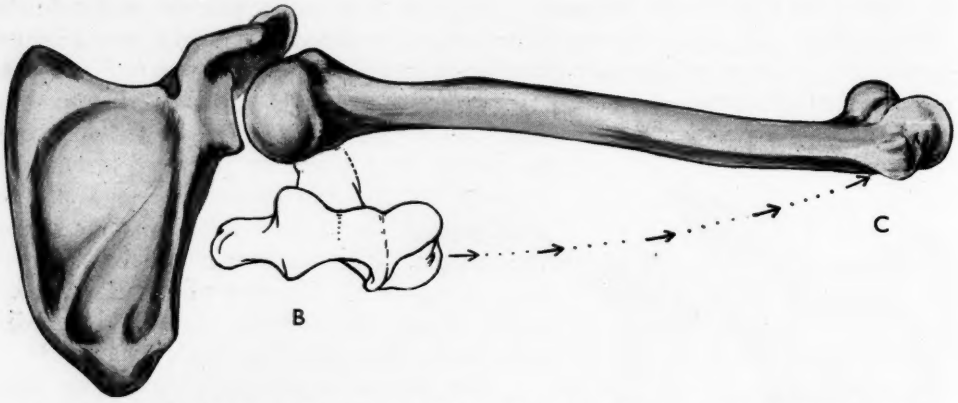


FIG. 185.—The humerus in B is flexed to a right angle; in C it has been swung backwards until it has reached the plane of the scapula. Note the direction of the medial epicondyle.

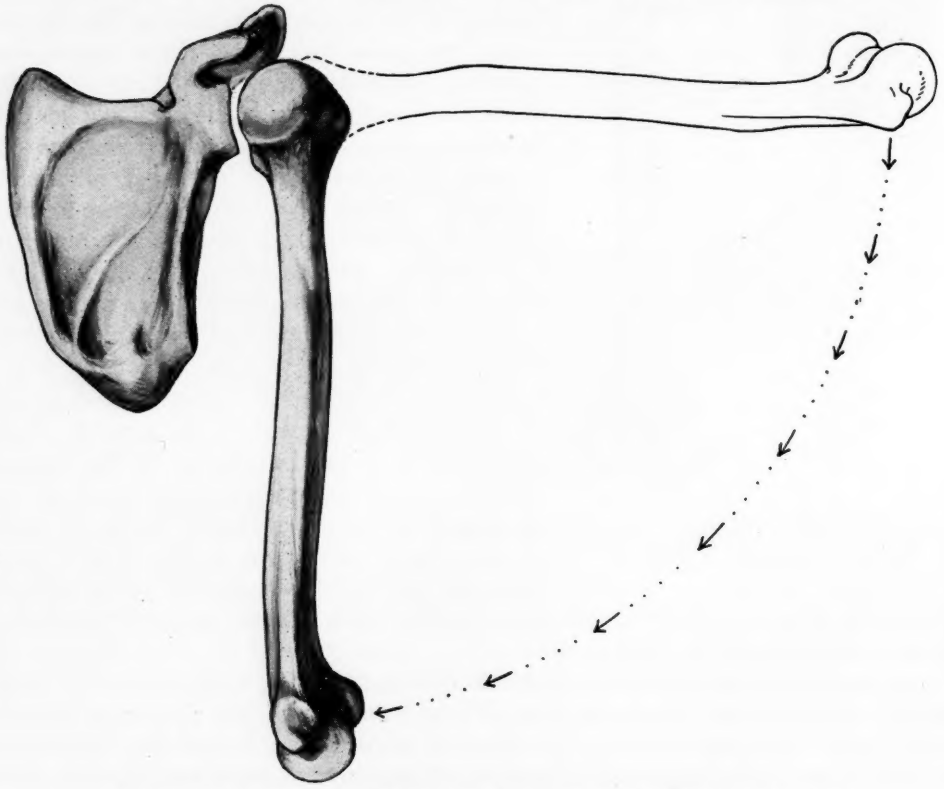


FIG. 186.—The humerus brought back to the vertical from Position C in *Fig.* 185. Note that the bone is now in the position of lateral rotation.

If a disarticulated humerus is placed in the resting position relative to the disarticulated scapula, its anterior surface faces forwards and medially (like the

costal surface of the scapula) and its medial epicondyle is directed medially (and slightly backwards).* We will call this Position A (*Fig.* 184). If the humerus is moved into the position of 'true flexion' at a right angle, the anterior surface looks almost directly upwards and the medial epicondyle points medially (Position B, *Fig.* 185). Now, without rotating the humerus around its long axis, and with the head pivoted in the glenoid cavity, the bone is swung backwards in a horizontal plane until it reaches the plane of the scapula.† The anterior surface then faces almost directly upwards and the medial epicondyle is pointing forwards (Position C, *Fig.* 185). Next, without rotating the bone around its long axis, it is restored to

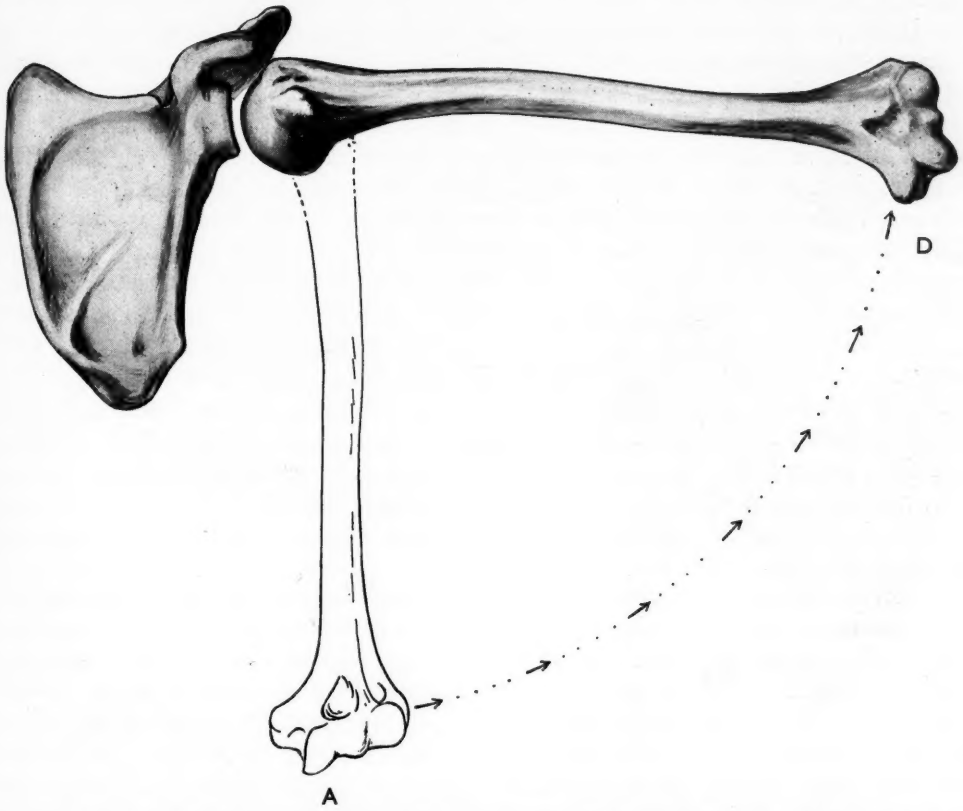


FIG. 187.—The humerus has been moved from the normal resting Position A through a right angle in the plane of the scapula to Position D, i.e., full 'true abduction'. Note the direction of the medial epicondyle, and compare with Position C in *Fig.* 185.

its original position (*Fig.* 186). The anterior surface now faces almost directly laterally and the medial epicondyle points forwards, i.e., by moving the bone through a right angle consecutively through three planes at right angles to each other, we have rotated it laterally through a right angle. Further study of these movements shows that this rotation always happens in an inanimate solid body, pivoted at one end and moved as described, and that it occurs during the second

* For the rest of the argument only the principal direction will be stated.

† To simplify the description as far as possible, the forward rotation of the scapula which occurs in the living subject has not been taken into account either in the text or in the figures. This omission does not affect the general argument in any way.

stage (i.e., in the transition from Position B to Position C), presumably because that movement occurs around a vertical axis.

To satisfy oneself that lateral rotation actually occurs during the second stage, it is necessary to consider what happens when the humerus is moved away from the scapula through a right angle in the scapular plane. In this, the position of 'true abduction', the anterior surface of the humerus faces almost directly forwards and the medial epicondyle points downwards (Position D, *Fig.* 187). When Position D is compared with Position C, it will be found that to convert Position D into Position C the bone must be rotated laterally around its long axis through one right angle.

It should be clear, therefore, that in the inanimate humerus the swing back from the 'truly flexed' to the 'truly abducted' position must be accompanied by lateral rotation through a right angle which is passively imposed on the bone. But, if such a movement were allowed to occur unopposed in the living body, it would interfere with the proper alinement of the supraspinatus, the subscapularis, and the anterior fibres of the deltoid, which must all be functioning with the maximum efficiency when the arm is elevated fully. In the living subject, therefore, this passive lateral rotation is counteracted by an active rotation of the bone medially around its long axis, so that when the bone reaches the scapular plane, it is in the mid-position, and rotated neither to the medial nor to the lateral side.

In a similar way one can demonstrate that if the disarticulated humerus is first 'truly extended' to a right angle, and then swung forwards into the scapular plane, it will be in a position of medial rotation, for the anterior surface is then directed mainly downwards and the medial epicondyle points backwards. When, therefore, in the living subject the arm is raised to the vertical in the coronal plane (i.e., a combination of 'true extension' and 'true abduction') the lateral rotators come actively into play and counteract the medial rotation which would otherwise be imposed passively on the humerus.

Stevens[9] has drawn attention to the important part which the short rotators of the humerus must play when the arm is raised to the vertical, in order to ensure the stability of the fulcrum and the appropriate balance between the opposing muscles when the limb is in this precarious and obviously unstable position. When the disarticulated bones are carried through the movements above described, it will at once become obvious how, during elevation in the sagittal plane (when the humerus moves from a position which is a combination of 'true flexion' and 'true abduction' into the scapular plane), the subscapularis and probably the supraspinatus and the clavicular fibres of the deltoid function as active medial rotators. In the same way it can be seen how, during elevation in the coronal plane, the infraspinatus, teres minor, and probably supraspinatus function as lateral rotators.

This explanation succeeds in harmonizing the apparently contradictory observations which were quoted at the beginning of this paper, but to establish it more emphatically it is necessary to consider some of the arguments which have been put forward by both Martin and Codman.

Codman's proof of the 'truth' of the paradox, previously quoted, is exceedingly ingenious. Firstly, he proves that in the fully elevated arm the humerus is in extreme lateral rotation in the following way. With the arm fully elevated and the elbow flexed, the forearm lies across the top of the head. Keeping the elbow flexed, the humerus is allowed to descend slowly in the coronal plane

" without rotation on its long axis ". When the arm reaches the side, it will be found that the forearm is pointing laterally, and that the humerus is therefore laterally rotated. He concludes the argument by saying, " Since you let it (the humerus) descend, without rotating it at all, it must have been in external rotation all the time. Q. E. D." During the performance of this movement, however, the humerus is carried from the scapular plane into the coronal plane, and in the process a degree of lateral rotation is imposed on the bone because it has been swung backwards around a vertical axis. When no restrictions are imposed, the subject actively rotates the humerus medially during the movement in order to counteract this lateral rotation. Secondly, he proves that the elevated humerus is in medial rotation as follows. With the arm elevated to the vertical and the forearm flexed, the humerus is allowed to descend " without rotating on its axis " in the sagittal plane. When it reaches the side, the forearm will be across the front of the body pointing to the opposite side, and the humerus is obviously rotated medially. In this case the humerus is swung forwards around a vertical axis as it is carried from the scapular plane into the sagittal plane, and a degree of medial rotation is imposed on it by the movement round the vertical axis.

Martin's explanation of the mode of production of lateral rotation as the arm is elevated in the coronal plane is that as the arm is raised " the greater tuberosity of the humerus comes into contact with the lateral edge and under surface of the acromion and coraco-acromial ligament. As the arch formed by these two structures is further from the glenoid cavity behind than it is in front, *the greater tuberosity slides backwards when it comes in contact with them and this rotates the humerus laterally.*" The italics are mine, for the author expressly excludes the infraspinatus and teres minor from any participation in the movement. Personally, I believe that, so long as the capsular ligament is intact and the short rotator muscles are functioning normally, no part of the greater tuberosity can ever come into contact with the acromion, and no such bony contact need be postulated to explain the movements. As has already being demonstrated, the rotation which occurs is produced actively, and in the living subject, as Stevens has pointed out, the active contraction of the infraspinatus can be observed during the movement.

The same writer assumes that because the humerus undergoes lateral rotation as it is being elevated, it must be in a position of lateral rotation when it reaches the vertical, and therefore the medial rotators must be on the stretch. To test this he examined what happened when a man, suspended from a horizontal bar by his two hands, held vertically above his head, lets go with one hand. He found that the trunk became rotated on the suspended limb, and apparently accepted that fact as supporting his contention, without going further into the matter. When the body is suspended from the right arm the central axis of the trunk of necessity becomes oblique under the influence of the force of gravitation. The left shoulder drops and the right arm is no longer vertical relative to the body. At the same time the trunk rotates to the left, a movement which might certainly be regarded as relaxing the strain on the right latissimus dorsi and the right trapezius, which must also be on the stretch in this position—the teres major may be left out of account as it does not pass to the axial skeleton. On the other hand, the rotation of the trunk would as certainly increase the tension of the pectoralis major and minor. It should be noted here that although the pectoralis major and the latissimus dorsi have similar rotatory values on the humerus, they have opposite rotatory values

on the trunk. This rotation of the suspended body is a very interesting phenomenon, but it is obviously associated more with the alteration in the centre of gravity of the body than with the relief of tension of any group of muscles, and until the various factors have been very carefully analysed—if, indeed, they are capable of complete analysis—it cannot be adduced in support of any argument.

At an earlier stage it was pointed out that the details of this argument, although not its main principles, are affected by the relation of the long axis of the humeral head to the long axis of the glenoid cavity in the resting position, and, following Fick,[6] I have assumed hitherto that the two axes were directly opposed. If, however, the long axis of the humeral head in the resting position is in front of the long axis of the glenoid cavity, some medial rotation of the humerus will be necessary to bring the bone into the scapular plane during the movement of 'true abduction'. Conversely, if the long axis of the humeral head in the resting position lies posterior to the long axis of the glenoid cavity, some lateral rotation of the humerus will be necessary to bring the bone into the scapular plane during the same movement. Personally, I believe that in the resting position the two long axes are so nearly opposed to each other that no appreciable amount of rotation can be attributed to this factor, and that any rotation which may occur during complete elevation to the vertical in the scapular plane can be accounted for by the alteration in that plane associated with the forward and rotatory movement of the scapula round the chest wall.

SUMMARY

1. A plea is put forward for the adoption of the scapular plane as the reference plane for the movements of flexion and extension, abduction and adduction, at the humero-scapular joint.

2. The fact that when the arm is raised to the vertical above the head the humerus is rotated neither to the medial side nor to the lateral side has been demonstrated.

3. The rotation which the humerus undergoes as it is elevated to the vertical in the sagittal and coronal planes has been shown to be an active movement designed to counteract the opposite rotation which is passively imposed on the bone during its passage, backwards or forwards as the case may be, towards the plane of the scapula.

REFERENCES

[1] MARTIN, C. P., *Brit. Jour. Surg.*, 1932, xx.
[2] CODMAN, E. A., *The Shoulder*, 1934. Boston, Massachusetts.
[3] MACGREGOR, LEE, *Brit. Jour. Surg.*, 1937, xxiv.
[4] CATHCART, C. W., *Jour. Anat. and Physiol.*, xviii.
[5] LOCKHART, R. D., *Jour. Anat.*, 1930, lxiv.
[6] FICK, R., *Bardeleben's Handbuch der Anatomie*, 1911.
[7] THANE, G. D., *Quain's Anatomy*, 10th ed., 1896.
[8] DUCHENNE, G. B., *Physiologie des Mouvements*, 1867, Paris.
[9] STEVENS, J. H., *Amer. Jour. Med. Sci.*, 1909.

SWELLING OF THE UPPER LIMB FOLLOWING RADICAL MASTECTOMY

By E. A. DEVENISH and W. H. GRAHAM JESSOP
ASSISTANTS, SURGICAL UNIT, UNIVERSITY COLLEGE HOSPITAL, LONDON

Radical mastectomy remains the method of treating operable carcinoma of the breast which gives the best late results. As it is likely that it will continue to be performed therefore, it is desirable to minimize any consequences of the operation which give trouble to the patient. One of these is post-operative swelling of the upper limb on the affected side.

Such swelling may take place in the absence of recurrence. It is the object of this paper to describe this form of swelling and to suggest a method of treatment. In order to ensure the exclusion of cases due to recurrence of the growth, only those have been selected who have remained alive and free from recurrence for at least five years after the operation, and who noticed the swelling for the first time at least two years before examination. They are all alive at the present time.

Incidence.—Of the cases of unilateral glandular carcinoma of the female breast treated by radical mastectomy in University College Hospital from 1922 to 1931 inclusive, 90 remain alive and free from recurrence at the present time. Fifteen of these have had some degree of swelling of the upper limb. The amount of swelling varies to a considerable extent throughout the group, but it may be arbitrarily classified as slight, moderate, and severe, including 8, 4, and 3 cases respectively.

The age distribution and stage of spread of the growth at operation do not present any significant features in so small a series. The details are given in *Table I.*

Table I.—Age Incidence and Stage of Growth at Operation

Case	Degree of Swelling	Age at Operation	Axillary Glands
1	Slight	68	Clinically free
2	,,	53	Histologically free
3	,,	58	,, ,,
4	,,	41	Histologically growth present
5	,,	44	,, ,, ,,
6	,,	58	,, ,, ,,
7	,,	72	,, ,, ,,
8	,,	72	,, ,, ,,
9	Moderate	38	Histologically free
10	,,	58	,, ,,
11	,,	59	,, ,,
12	,,	48	Histologically growth present
13	Severe	47	Clinically free
14	,,	49	Histologically free
15	,,	47	Histologically growth present

Onset.—In 10 cases the patients stated that the swelling developed gradually during the few weeks immediately following the operation. In the remaining 5 cases a definite period elapsed, respectively six weeks, one year, seven years, seven and a half years, and sixteen years, before any swelling was noticed.

Cause.—The problem of the determining factor in these cases of late swelling is of great interest and of considerable difficulty. Further work is being done in an attempt to find a satisfactory explanation. In the present series there was one case in which the onset coincided with an attack of acute bronchitis. In the remainder there was no history of any coincident illness, although this was carefully inquired into.

FIG. 188.—Swelling above medial epicondyle.

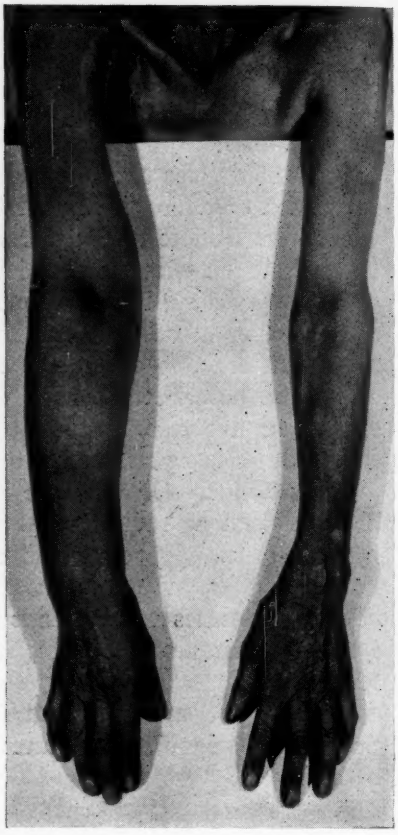


FIG. 189.—Swelling of dorsum of forearm.

Halstead[1] suggested that infection was the underlying cause. In the above group there was healing by first intention in every case, and certainly no gross wound infection. We also saw three cases not included in the above group, in one of which the wound did not heal by first intention.

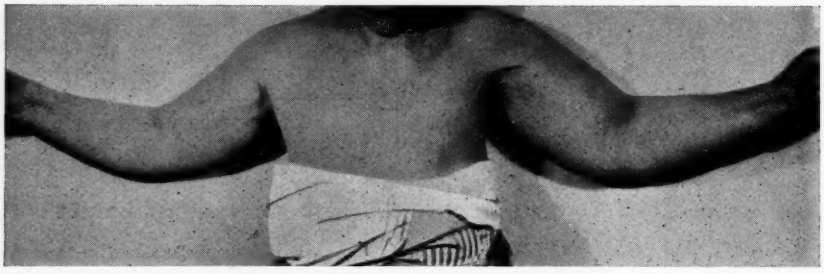


FIG. 190.—Bagginess of back of arm.

Degree and Distribution of Swelling.—On examination for the purpose of this investigation the affected limbs showed a wide range of swelling. When very slight it was confined to the postero-internal aspect of the arm just above the medial epicondyle (*Fig.* 188), or to the dorsum of the lower third of the forearm (*Fig.* 189). A lax vertical fold of skin over the back of the arm was filled out in one woman, producing an unsightly bagginess (*Fig.* 190). This was associated with a moderate uniform enlargement of the whole forearm.

When more extensive the swelling produced a cylindrical or fusiform enlargement of both the arm and forearm. The dorsum of the hand was ballooned out

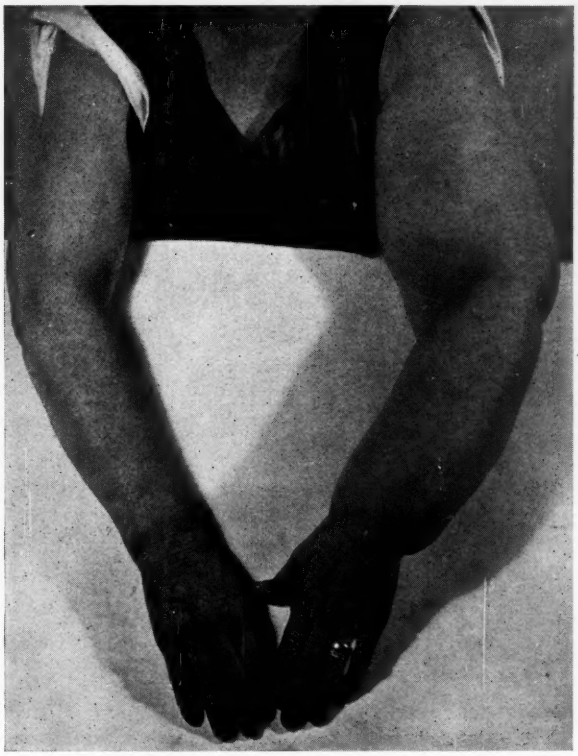


FIG. 191.—Absence of swelling of dorsum of hand in severe case.

in a few cases. In others, with gross distension of arm and forearm, the hand remained strikingly normal (*Fig.* 191). There was always a well-marked constriction at both the elbow and the wrist extending round the whole circumference and corresponding to the flexure crease. The upper border of the swelling in the arm was less clearly defined. It faded out about the level of the anterior axillary fold, except in the most severe cases, and was more easily recognized by palpation than by inspection. In no case was there any swelling of the chest wall or shoulder. When greatly stretched the skin showed a fine superficial scaling and the pilo-sebaceous orifices were wide and prominent.

The biggest limb seen is illustrated in *Fig.* 192. The swelling extended from the delto-pectoral groove to the roots of the fingers, sparing only the palm of the

hand. There was a great uniform cylindrical enlargement of the arm, fusiform swelling of the forearm, and a filling out of the dorsum of the hand. The constrictions at the elbow and wrist were well marked. The volume of the affected limb measured by a displacement method was some three times greater than that of the opposite, normal, limb. The skin was shiny, and over the dorsum of the forearm reddened. The digits were normal.

In each case the nature of the swelling was carefully observed. It always consisted of two kinds, one pitting, the other non-pitting. Two cases showed no pitting œdema, but both stated that pressure marks appeared after wearing a tight

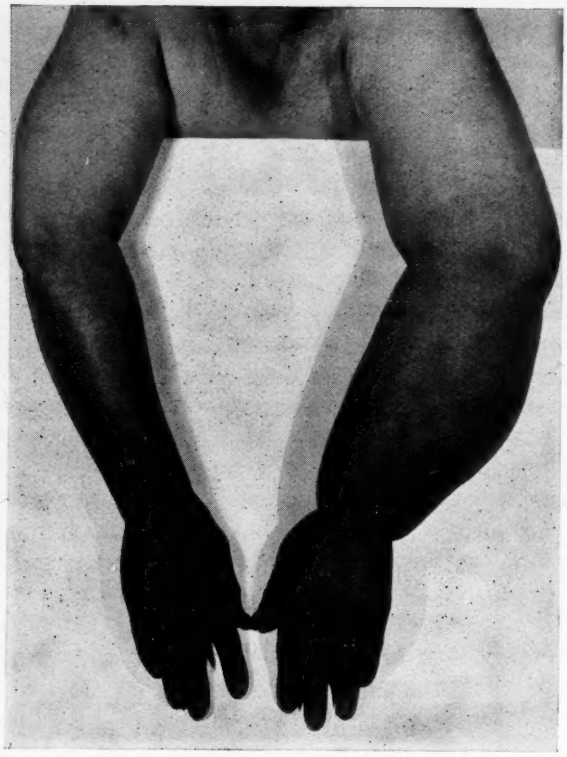


FIG. 192.—Maximum swelling of whole limb.

garment. In each of the remaining cases pitting was obtained over some part of the limb, but not necessarily over the whole of the swollen area. In one case it was only obtainable over the flexor aspect of the forearm, in the second over the dorsum of the forearm, although both had moderate swelling of arm, forearm, and hand. The patient illustrated in *Fig.* 192, with maximum swelling of the whole limb, had deep pitting œdema everywhere. Shrinkage following continuous suspension of the limb occurs most rapidly in the areas which pit on pressure.

Variability.—With one exception all the patients stated that the degree of swelling varied from time to time, but they differed considerably from one another as to the cause. The majority found that the swelling increased after work, or at the end of the day, or after walking. Two patients referred to the effect of the seasons, one finding the arm worse in summer, the other finding it worse in winter.

Disability.—In most cases the degree of disability was proportional to the amount of swelling. The patients complained that the limb felt far too heavy, rendering work with it unduly fatiguing. In two cases with fairly extensive swelling the patients were quite definite that they had no interference with function.

With considerable swelling the necessity for having special sleeves made for all garments was a source of inconvenience and expense, whilst at the same time the unsightly appearance caused some distress.

Inflammation.—Attacks of inflammation in the swollen limb were described by five out of ten patients, but none has been actually observed by us. One patient noticed that the arm increased in size for four or five days following cuts on the fingers. Another experienced a similar change following gnat bites. In one case there had been two attacks of redness and swelling, both of which occurred during influenza. The patient shown in *Fig.* 192 said she had had several attacks of inflammation in the previous two years. They were always associated with fever and general malaise, causing her to remain in bed for three days each time.

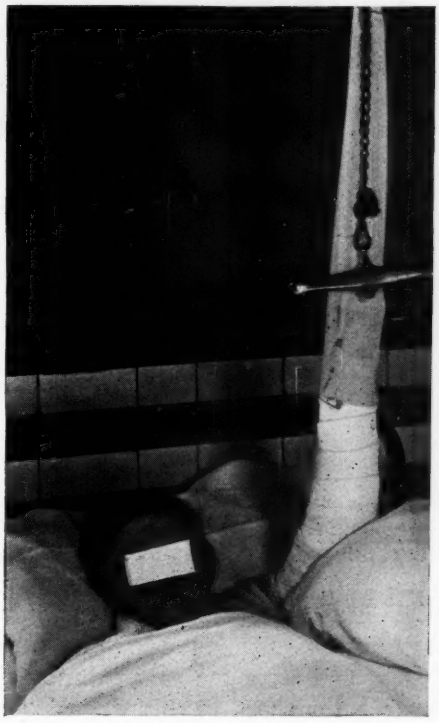


FIG. 193.—Method of suspension.

In no case was inflammation followed by a permanent increase in the size of the limb, nor was it present at the onset. Except in one patient it did not produce effects of any severity.

Treatment.—Four cases with severe swelling were treated by the method of continuous suspension of the limb illustrated in *Fig.* 193. The patient was kept in bed and the limb suspended from the hanging chain by a 6-in. bandage. The latter was secured by safety-pins to the distal turn of a flannel bandage which was applied firmly and evenly to the whole limb from the axillary folds to the interdigital clefts. When there was no swelling of the dorsum of the hand the bandage ended at the wrist. Suspension was maintained up to 24 hours a day, in the cases able to tolerate it, for a period of from four to ten weeks. In the later cases massage was given daily, the suspension of the limb being interrupted for this purpose.

Shrinkage of the limb followed this treatment in every case to a degree proportional to the amount of pitting œdema present at the beginning. The rate at which shrinkage took place was estimated by displacement measurements of the volume of the limb. In one case the volume diminished by 3 litres in 15 days, but in the remainder it was considerably slower.

In no instance was a complete restoration to normal brought about. The residual swelling was of a brawny, indurated consistency and did not pit on pressure. In the first case, which was treated a year ago, there was no obvious difference

in size on inspection between the normal and affected limbs at the completion of treatment. In the other cases the shrinkage was less complete, but sufficient to enable normal garments to be worn.

When the maximum reduction in size following elevation and massage had been obtained, the limb was fitted with a light corset as shown in *Fig.* 194. This was made of thin, perforated rubber, with an arrangement for lacing up to obtain

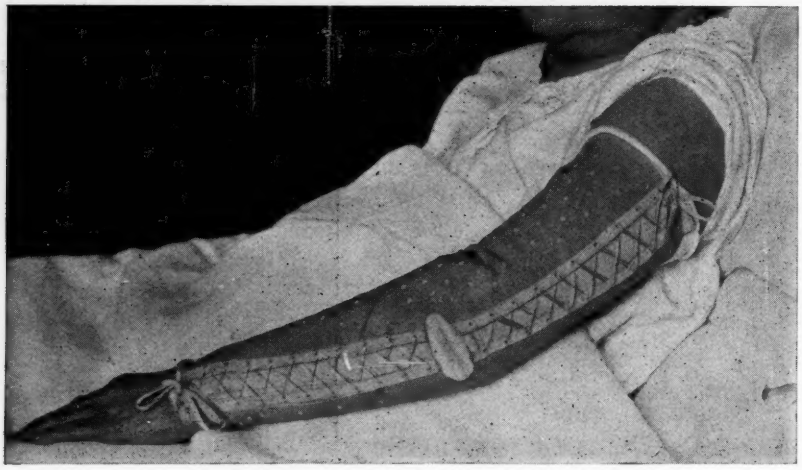


FIG. 194.—Corset fitted.

a uniform pressure on the skin. Care was taken to avoid the formation of creases, especially in the region of the elbow, by accurate fitting and by the excision of an ellipse on both flexor and extensor aspects.

This corset was found to work quite well in practice. The most satisfactory result was obtained when the patient continued to have the arm suspended at night and wore the corset during the time she was up and about. The swelling of the limb was in this way adequately controlled and the ability to use it much extended, whilst the patient was able to wear normal-sleeved garments.

SUMMARY

1. Post-operative, non-malignant swelling of the upper limb occurs in one out of every six patients after undergoing radical mastectomy.

2. It reaches a size sufficient to cause some trouble to the patient in rather more than one-third of those affected.

3. It does so by rendering the limb heavy and fatiguing to use, by causing disfigurement, by necessitating the wearing of special sleeves, and by producing undue susceptibility to inflammation.

4. Marked shrinkage of the limb follows continuous suspension. Recurrence of the swelling is prevented by a light corset.

REFERENCE

[1] HALSTEAD, W. S., *Bull. Johns Hop. Hosp.*, 1921, xxxii, 309.

A CASE OF RETROPERITONEAL CYST, WITH A CLINICAL STUDY OF THE SUBJECT

By MAHMOUD HAFEZI, London

Retroperitoneal tumour, or what is sometimes vaguely called "mesenteric tumour", the post-mortem curiosity of the sixteenth to the eighteenth centuries, and the surgical puzzle of the nineteenth century, has ceased to be a rarity, for about 500 cases have been reported; but it still remains somewhat of a problem to the diagnostician in spite of the advanced auxiliary methods of diagnosis now available, while its surgical treatment often presents serious considerations. This perhaps is due to the diversity of its situation, the complexity of its origin, and its still comparative infrequency, so that no one surgeon is likely to encounter more than a very few cases.

The case here recorded owes its particular interest chiefly to the difficulty of its diagnosis, and this perhaps was due to its rather unusual situation.

CASE REPORT

History.—E. G., an unmarried female of 31, of responsible secretarial occupation, accidentally felt a 'lump' in her left side shortly before Christmas, 1934, but being at the time very upset over a recent bereavement she paid no attention to it.

During the Christmas week, arriving home from her office one evening, she was taken ill with a sudden severe attack of pain, generalized over the abdomen, and later settling in the right iliac fossa and 'shooting' to both sides of the neck. The acute pain lasted four hours and gave place to a dull ache. She vomited ten minutes after the onset and again next morning. The dull ache lasted a week. Acute appendicitis was suspected by the practitioner in attendance, but operation was not performed apparently because of the discovery of the lump, which was taken to be an 'enlarged spleen'. After six weeks in bed, during which time she felt very weak, the patient returned to work and gradually improved until she could carry out her usual duties. Large doses of iron were administered, in spite of repeated negative findings on blood examinations.

She felt quite well, and was planning a holiday abroad, when on July 26, 1935 (seven months after the first attack), again on her return home from the office, she was taken ill with an attack similar to the original one though milder in degree. She felt sick, but did not vomit. This attack subsided after four or five days in bed. At the beginning of August she was well enough to make a long journey by train.

When seen on Aug. 3, in addition to the above-mentioned history, the following points were elicited. Though the appetite was poor, digestion was quite good. She had been in the habit of taking Gregory's powder at regular intervals since early girlhood, and this ensured a regular action of the bowel. There were no urinary symptoms and no cough or chest trouble. No pain after bus rides or exercise. No headaches or fainting sensations. "Rheumatic fever which affected the heart" at the age of twelve, but "quite healthy" since except for intrinsic dysmenorrhœa and a severe menorrhagia three years ago.

On Examination.—An apparently healthy young woman of a good colour. Pulse and temperature normal. Tongue, mouth, and throat clean. Neck showed no swelling or other abnormality. Breasts were normal. Lungs normal. No glands in the axillæ. No bruits heard over the heart, but the apex beat was well outside the mid-clavicular line.

Abdomen.—There was no distension and the umbilicus was not protruded. A tumour was visible in the left side causing slight bulging of the costal margin, and moving on

respiration. The tumour was directed towards the umbilicus from the left hypochondrium, and reached down to the level of the umbilicus and even below it on deep inspiration. It had a smooth surface and a regular rounded outline except for a 'notch' just to the left of its most prominent part near the umbilicus (*Fig.* 195). It felt solid and was dull on percussion all over, the upper limit reaching the 6th rib in the mid-axillary line. To all intents it had the appearances and physical characters of an enlarged spleen. The liver was not palpable. The left kidney could not be felt apart from the tumour, and there was no tenderness in the renal angles and no rigidity or tenderness elsewhere in the abdomen. Pelvic examination revealed no abnormality.

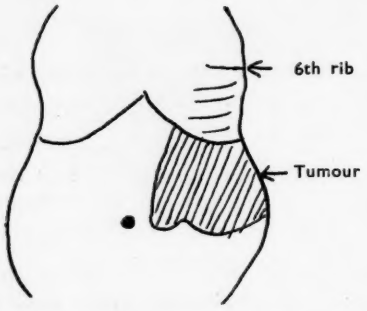


FIG. 195.—Diagram showing the position of the tumour.

A tentative diagnosis of an enlarged spleen was made on the ground of the position and direction of the tumour and the 'notch', although this was not quite in a typical position.

Hæmatological Investigations (Aug. 6). — These showed: Red blood-cells 4,800,000; Hæmoglobin 76 per cent; Colour index 0·79; White cells 10,700 (polymorphs 75 per cent, lymphocytes 18 per cent, large mononuclears 4 per cent, eosinophils 3 per cent); Platelets 300,000. Bleeding time 1 minute 48 seconds. No reticulocytes seen among 1000 red cells. No abnormal cells seen among 1000 white cells. Fragility within normal limits. Van den Bergh's test gave both direct and indirect negative. Wassermann reaction negative. Kahn's reaction negative.

Urine.—Acid, albumin present, a trace of blood. Sterile on culture. Occasional granular casts.

Intravenous Urography.—This was not successful, as the injection of uroselectan B was discontinued on patient's complaining of pain in her arm.

After these negative findings, the diagnosis was more in favour of a tumour of the spleen rather than of splenomegaly associated with a blood disease. After consultation with Dr. Aitken, who thought that the tumour was more likely to be renal than splenic, an exploratory laparotomy was decided upon.

OPERATION (Aug. 15).—Professor Grey Turner operated under intratracheal gas and oxygen and ether administered by Dr. Woodfield Davies. A long left paramedian incision was made from the costal margin to three inches below the level of the umbilicus. On opening the peritoneum, a bluish tumour presented itself with very large tortuous veins over its rounded surface, pushing the great omentum forwards, the stomach upwards and to the right, and the colon downwards. The spleen was attenuated and was spread out on the surface of the tumour to which it was universally adherent, but was otherwise normal. The left kidney was found to be free of the tumour, but displaced a little downwards. The size of the tumour, however, necessitated a better exposure, which was achieved by making a second incision from the middle of the paramedian incision and through the left rectus well back into the flank.

The tumour was found to be like a large fœtal head, partly cystic, and notched at its lower pole. It was located behind the peritoneum of the posterior wall of the lesser sac, and was adherent to the abdominal wall, the diaphragm, the spleen, and the tail of the pancreas. At this stage, it was considered safer to remove the spleen along with the tumour. The very vascular adhesions were clamped and divided. The peritoneum at the upper pole of the tumour was incised and the tumour shelled out fairly easily except where it was adherent to the tail of the pancreas. The cystic portion burst during these manipulations and discharged a great deal of greenish-yellow fluid and thick golden-yellow material (like baked custard). The gastrolienal ligament (or rather what remained of it) was divided between clamps and then the pedicle of the spleen was clamped, cut, and ligatured. Finally, the tumour was dissected off the tail of the pancreas with a shaving of this structure and thus completely removed with the attached spleen.

The posterior wall of the lesser sac was roughly re-peritonealized, leaving a drain in the tumour bed and the vicinity of the traumatized pancreas. A second drain was inserted into the lesser sac, which also was reconstructed. These two drains were brought out of the outermost part of the wound and the abdomen was carefully closed.

The loss of blood was necessarily appreciable, and the patient was rather shocked about the middle of the operation, but she soon responded to a pint of glucose saline given into the great saphenous vein just above the left ankle.

AFTER-PROGRESS.—That evening the pulse improved, and the dressing, being found soaked with blood, was changed. The convalescence was fairly smooth except for some abdominal distension on the second day, which was relieved by a glycerin enema. The wound discharged some serous material for about a week and there was a slight reaction during a few days. On Sept. 15 the patient felt well enough to go home, though she looked rather pale. A blood-count report was as follows: Red cells 3,400,000; White cells 9000; Hæmoglobin 63 per cent; Colour index 0·9. Red cells show poor staining and slight anisocytosis. She was given a tonic, and discharged on Sept. 21 in good condition.

On Nov. 1 patient reported in person. She looked and felt very well, volunteering the statement that she had gained one stone in weight. There was no sign of recurrence.

Eighteen months later the patient reported herself as very well in every way.

PATHOLOGICAL REPORT.—The specimen as received weighed 930 g. and consisted of a slightly enlarged spleen to which a large growth, mostly cystic, was attached. The fluid in the cyst was blood-stained, and there were two large solid areas projecting on the inner wall of the cyst, the larger being about the size of a fist (*Fig.* 196). These solid areas showed caseous portions of a bright chrome colour, very like the colour of a hypernephroma. Other parts showed cystic cavities filled with mucus. In addition, the main cyst showed shaggy brownish material on its inner wall, evidently large blood-clot. The spleen itself showed

FIG. 196.—Tumour with the spleen in section. A, Area from which Block I was taken (*see Fig.* 197); B, Area from which Blocks II and III were taken (*see Figs.* 198, 199).

a simple wedge-shaped recent hæmorrhagic infarct, about one inch in diameter, at its base (under the capsule).

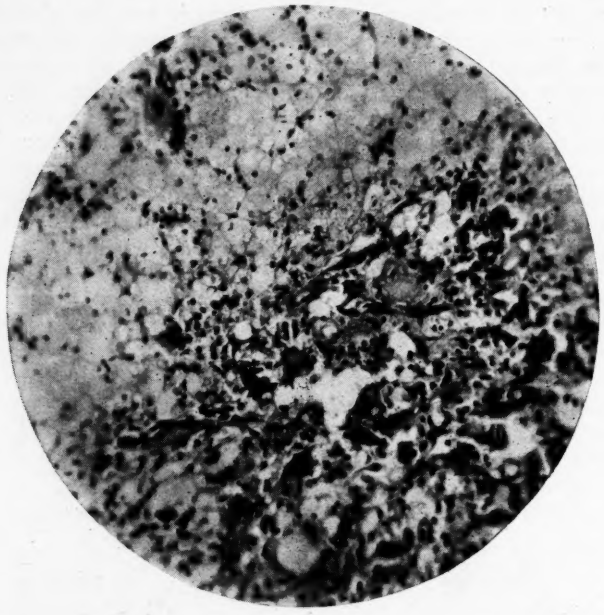


FIG. 197.—From the more solid part of the tumour, A in *Fig.* 196. It shows the giant-celled and hypernephroma-like tissue.

FIG. 198.—From B in *Fig.* 196. Shows appearances like normal intestinal mucosa.

HISTOLOGY.—

Spleen.—Simple recent bland hæmorrhagic infarct, evidently due to mechanical interference with blood-supply by the growth, but no actual invasion by tumour.

Blocks were taken from three areas in the growth.

Block I (*Fig.* 197).—The two types of tissue visible here were: (*a*) Areas with large polygonal cells with abundant clear cytoplasm and small nuclei. Such areas resemble suprarenal cortex to a considerable degree. Subsequent frozen sections from similar tissue showed that the cells were distended with fat. On the whole it was concluded that these cells were not tumour cells but were more of the nature of macrophages. (*b*) Separating up the areas just described there was an extremely cellular tissue. Many of the cells were of irregular spindle shape, but a large number were giant cells, sometimes with up to three or four nuclei. There were other cells transitional in appearance between the various spindle forms and the giant cells. There was great variation in the size and shape of nuclei, many of which were hyperchromatic. The appearance of this type of tissue suggested malignancy, although the exact nature and origin of the cells was extremely difficult to determine.

This block was taken from one of the chrome coloured areas and its fatty content explains the colour.

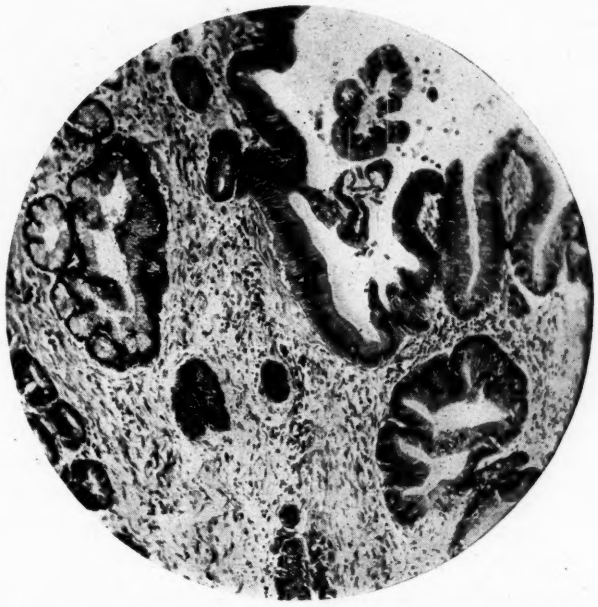


FIG. 199.—Also from B in *Fig.* 196. Shows less typical gland tissue, with nuclei no longer basal. Also papilliferous cyst arrangement.

Blocks II and III.—These showed an entirely different histology. Some parts showed secreting glands lined by a single layer of tall columnar epithelium, the cytoplasm of which was distended by secretion. The nuclei were regular and basally placed. The glandular tissue was normal in every way, including a normal basement membrane, and the whole appearances in such areas were indistinguishable from those of normal glands of intestinal mucosa. In particular, there was a strong resemblance to the normal Brunner's glands (*Fig.* 198).

At other parts, however, a glandular arrangement was found which was less regular and more neoplastic in appearance. Sometimes typical papilliferous cystadenoma was formed, the cysts being either small or large and containing a colloid-like material. The individual cells showed some metaplasia from the appearance found in the more normal-looking glands described above, and were of somewhat variable shape and size, although generally they still retained a more or less columnar form, and although they still sometimes contained considerable amounts of secretion. In a few places this metaplasia was so decided that the picture resembled in some degree that of adenocarcinoma, the cells even tending to form little solid groups; but on the whole it was thought that there was not any definite malignancy in this tissue (*Fig.* 199).

The fluid from the cyst contained blood, protein, and sodium chloride, but no urea or bile. The deposit consisted of blood-cells, macrophages, fat, and cellular debris.

Summary.—It is difficult to explain the appearances found. It seems fairly certain that the growth represents a congenital cystic tumour largely composed of intestinal glandular epithelium. It is a little doubtful whether the changes found in the first block are to be regarded as merely reactive or whether there is actually a malignant component represented there. It seems possible that some malignancy does exist, but unlikely that it has spread beyond the confines of the tumour itself. There is no proof that any tissues other than intestinal epithelium, except connective tissues, are represented in the growth.

DISCUSSION

Most of the cases that the writer has come across in the literature of the subject seem to be located in the lower abdomen or in the pelvis, and to be often diagnosed as ovarian cyst—the most common cyst in this situation.

On close examination of the specimen described in this paper, the cyst appears to have arisen between the spleen and the stomach in the gastrolienal ligament. The histology of the tumour is fair evidence of its enteric origin and is in full accordance with its site, since it is in the mesogastrium of this region that the primitive gut sends out its diverticula to form the accessory organs. It is quite easy to understand how aberrant cells in this region may, at a later date, take on a neoplastic role. R. L. Stewart suggests that there is evidence of large diverticula actually being separated off the intestines and producing cysts. He classifies the developmental retroperitoneal cysts into: (*a*) Lymphatic; (*b*) Enterogenous; (*c*) Mesocolic (Handfield-Jones); (*d*) Urogenital; (*e*) Dermoid or teratomatous. There are also the traumatic blood cysts and the parasitic hydatid cysts.

The solid retroperitoneal tumours include lipomata, fibromata, fibrolipomata, myomata, sarcomata, and tumours of the regional lymph-glands. In the days of Péan and Spencer Wells, the lipomata in this situation reached record sizes and weights, and their surgery presented some of the most severe operations. William Anderson in 1896 writes that operation on these cases proved dangerous owing to the large size of the tumours, shock, and the intractable diarrhœa that often followed operation, the latter complication being due to damage to the blood-supply of the intestines. Alban Doran in 1904 quotes Bégouin of Bordeaux and agrees with him as to the high operative mortality of these cases, although he reports a successful removal of a fibromyoma weighing 30 lb. in a multipara of 34 years. But cysts are now rarely as large as that and perhaps are easier to remove.

CLINICAL FEATURES

From the clinical standpoint, the subject presents a still more difficult and often puzzling problem. There are no characteristic symptoms and signs, no definitely regular site, and they are too rare to arouse suspicion. They are definitely more common in females than in males, in the proportion of 10 to 3 (Doran), and have been recorded in infants of four months and adults of eighty years (Moynihan).

Symptoms.—Moynihan divides the cases into three varieties:—

1. Those which have no symptoms whatsoever. These are either discovered accidentally at post-mortem or during routine examination of a patient. A case is reported of such a cyst being discovered during the examination of a candidate at a baby show.

2. Those which take a chronic course. Most of the patients complain of a tumour and little else. Others complain of pain, indigestion, and constipation. The pain is either local, radiating to flanks, thighs, or groins (in the case reported here to both sides of the neck), or maybe colicky due to vermiculations of hypertrophied intestine. Attacks of acute pain may arise from hæmorrhage into the cyst and increase in its size. This probably accounts for the two attacks in the case here reported. There is usually no tenderness in the abdomen. Constipation is the rule. Meteorism, vomiting, or diarrhœa may sometimes occur. The patient usually loses weight owing to interference with the lacteals in the mesentery. The duration of symptoms may be from a few months to a few years.

3. Those in which acute abdominal symptoms, often obstructive in type, are the first indication of something wrong. Such symptoms may be caused by the following factors: (*a*) Irritation of the solar plexus by the pedicle of the cyst (Collet); (*b*) Compression of the intestine in some cases causing gangrene (Sutherland); (*c*) Adhesions; (*d*) Onset of acute peritonitis owing to rupture of the cyst (Charet and Davaine); (*e*) Strangulation over a band formed by the pedicle (Moynihan).

Physical Signs.—The most constant physical sign is a cystic tumour. The cyst is generally rounded, even or lobed (as in the case reported). The most prominent part of the tumour is generally near the umbilicus, which incidentally never becomes protruded. The most characteristic feature of the cyst is its free mobility. This, of course, is greatly limited or even absent where adhesions are present or where the cyst is partially hidden and trapped under the costal margin, as in the case reported here. Fluctuation can sometimes be elicited, especially if the cyst wall is thin. On percussion there is a zone of complete resonance all round the tumour, and the tumour in most cases can be shown to have no connection with the liver, spleen, kidney, or pelvic organs. Sometimes a resonant band can be elicited across the cyst. In the case recorded here no such signs were elicited, principally because the cyst was deeply situated, but also because its wall was thick and its contents too viscid. In cysts which reach the pelvis, putting the patient in the Trendelenburg position might enable the surgeon to outline the lower border of the tumour.

DIAGNOSIS

Differential Diagnosis.—This must be made according to the situation of the tumour from: ovarian or parovarian cyst or other pelvic tumours; enlarged kidney, spleen, or liver; cysts of urachus; pancreatic cysts; solid mesenteric growths; mucocele of the gall-bladder; cold abscess; and, when urgent symptoms arise, all the conditions gathered under the term ' the acute abdomen '.

Direct Diagnosis.—Vagueness of symptoms and failure of an abdominal cystic tumour to comply with the features of other more common tumours of this region should perhaps arouse a suspicion of retroperitoneal cyst in the clinician's mind. When the cyst is rounded, smooth, not tender, and quite mobile, this suspicion is on the way to being confirmed. The mobility, of course, depends on the absence of adhesions, and is most pronounced when the cyst is in the mesentery proper. In this situation the free mobility in a transverse direction, as compared with mobility in a vertical direction, is particularly striking. Lockwood lays stress on irregular and indefinite areas of dullness and resonance alternating. Pain is

more frequently present in association with retroperitoneal cyst than with other abdominal cystic tumours.

Pressure effects are more pronounced in cases of retroperitoneal tumours than in those of intraperitoneal origin. This is particularly well shown in relation to the ureter, and is easily understood when one remembers how in stripping the peritoneum at operation the ureter clings to this structure and is lifted up with it. Therefore any tumour originating behind the peritoneum of the posterior abdominal wall or at the root of the mesentery—which is perhaps the commonest site for these tumours—will eventually produce a ureter displaced, flattened, and stretched over its surface. Here, especially in deep-seated cysts which are not markedly mobile, a pyelogram is of great diagnostic value, as the obstruction and the dilatation proximal to it will be clearly shown. Theoretically, it may even be possible to distinguish a cyst of mesocolic origin (Handfield-Jones) from one of urogenital origin, as the former anatomically is lying in front of the ureter and therefore should not cause any obstruction. Again, for similar anatomical reasons, differentiation between these two types ought to be possible by means of a barium enema showing indentation of the ascending colon—on its medial side by cysts of mesocolic origin and on its lateral side by cysts of urogenital origin. In the case reported here perhaps a barium meal as well as a barium enema would have given some clue to the nature of the tumour, as both the stomach and the splenic flexure were markedly displaced and indented and the rounded shape of these indentations might possibly have excluded the possibility of the spleen causing them, since this organ tends to keep its general shape and outline even on gross enlargement.

Diagnostic puncture and aspiration is to be condemned, of course, owing to the risk of leakage and injury to the large veins.

In spite of all these various means of diagnosis, perhaps most of the cases come to exploration with only a suspicion of the nature of the tumour, and therefore the surgeon must be prepared for all the difficulties that such an exploration may reveal.

COMPLICATIONS

If not operated upon, these tumours may very occasionally retrogress, but are much more likely to continue to grow and to give rise to complications. These may be :—

1. Perforation into the intestine and discharge of contents therein. This is perhaps the best that can happen, though it does not necessarily result in a cure.
2. Perforation into the peritoneal cavity, giving rise to peritonitis.
3. Extreme emaciation of the patient, probably due to compression of the lacteals in the mesentery.
4. Acute intestinal obstruction. This is perhaps the commonest complication, and is a mechanical process due to kinking, narrowing, volvulus, adhesions, and even intussusception. The mortality rate is 50 per cent.
5. Hæmorrhage into the cyst.
6. Torsion of the cyst.
7. Impaction into the pelvis causing obstructed labour.

TREATMENT

Surgery is the only effective treatment, and it can be carried out in several ways according to individual circumstances. It is not easy to foretell what type of operation can be performed until the abdomen is opened and the tumour carefully examined.

Difficulties and Dangers in the Surgery of Retroperitoneal Tumours.—These are as follows :—

1. *Shock.*—Usually marked, especially while dividing the adhesions, loss of blood from this manipulation and from the dilated tortuous veins being the main factor.

The patient's blood must therefore be typed and a suitable donor secured in case of need.

2. *Adhesions.*—Parietal adhesions are not common, but adhesions to the neighbouring viscera make enucleation difficult in about half the cases. The surgeon must carefully ascertain the relations of the tumour before a single adhesion is divided, as viscera may be displaced or ectopic. The ureter, in particular, must be looked for.

3. *Neighbouring Organs.*—These often are so intimately related to or involved by the cyst that separation by dissection is either impossible or risky to the viability of the organ. Where the intestine is stretched over a cyst which has separated the two layers of the mesentery, injury to the blood-supply of that segment gives rise to an intractable post-operative fœtid diarrhœa and even a fatal gangrene of that segment of the bowel. In such cases it is much safer to resect the involved loop of bowel. When the spleen is involved, as in the case reported here, removal of that organ not only makes the operation safer, but it reduces the length of the operation considerably. Adhesions to the pancreas must be very carefully separated. The pancreas may safely be shaved off if necessary as long as it is properly drained, as was done in this case.

4. *The Capsule.*—Although the skin incision should be long enough to give a thoroughly good exposure, the incision in the mesenteric or peritoneal capsule should be as small as possible so as not to endanger the important blood-vessels in this structure. It is often possible to reduce the size of the cyst by aspiration of its contents prior to its extirpation. The bruised edges of the rent in the capsule must be trimmed and closed, allowing a drain to be inserted in the tumour bed. Troublesome oozing can effectively be controlled by gauze packing.

Operative Measures.—J. Ogle Warfield, jun., in reviewing 131 cases, gives the following alternatives :—

1. *Enucleation* is the method of choice, but is possible in only half the cases. Operative mortality of 9 per cent is the lowest figure recorded. It is to be recommended wherever it is safely possible.

2. *Enucleation* + *Resection* of adherent organs (total or partial), as far as permissible by general surgical and physiological principles, is certainly the safest method where there is the slightest doubt that the viability of the organ may be endangered by the process of dissection. This procedure carries with it a mortality of 27 per cent.

3. *Marsupialization* or *Simple Drainage* for about three months is the only method available where the other two methods are either impossible or contra-indicated owing to the general condition of the patient or involvement of vital organs or structures. Though not an ideal proceeding, it may be quite effective. Moynihan advocates it for the acute cases especially. Its mortality rate is 16 per cent.

4. *Aspiration*, which was practised by the older surgeons, is condemned on grounds already referred to.

PROGNOSIS

Every case must be judged on its own merits, since the factors affecting this problem are numerous. Quite a number of these cysts show some sign of malignancy in some part of their complicated structure. The malignant tissue is fortunately often so limited to within the capsule that the question of metastatic deposits does not often arise. Therefore the histology of the different components of the cyst is a very important factor. Other points in the prognosis are the size, location, and attachments of the cyst, the duration of its existence and the time of the operation, the type of operation, complications, and finally the age and the general condition of the patient.

CONCLUSIONS

1. A case of retroperitoneal cyst with rather unusual features is described, including its pathology and treatment.

2. A short survey of the clinical, diagnostic, therapeutic, and prognostic features of the problems is presented.

I am indebted to Professor Grey Turner for permission to publish this case, and for valuable help and suggestions. My gratitude is also due to Dr. Gray, of the Department of Pathology, for the pathological report and the photographs.

REFERENCES.

ANDERSON, WILLIAM, *Brit. Med. Jour.*, 1896, ii, 1087.
DORAN, ALBAN, *Ibid.*, 1904, 1075.
HANDFIELD-JONES, *Brit. Jour. Surg.*, 1924, xii, 119.
MOYNIHAN, *Ann. of Surg.*, 1897, xxvi, 119.
PHILLIPS, H. A., *Brit. Jour. Surg.*, 1934, xxi, 637.
STEWART, R. L., *Edin. Med. Jour.*, 1926, xxxiii, 432.
WARFIELD, J. OGLE, jun., *Ann. of Surg.*, 1932, xcvi, 329.

TRAUMATIC RUPTURE OF INTRAMESENTERIC DIVERTICULA OF THE JEJUNUM

By R. WEEDEN BUTLER, Cambridge

Multiple diverticula arising at the mesenteric border of the jejunum produce a condition which, although rare, has received a considerable amount of attention in the literature in the last few years. Although various writers differ in their opinions as to the exact mechanism of their initial formation, there is general agreement that the diverticula push out at first directly into the mesentery, and subsequently, as they enlarge by stretching of their walls, come to lie to one side or the other of the mesenteric border of the bowel, where they may increase to a diameter of two or three inches. Moreover, there is no question that the points of origin of the diverticula are related to the vasa recta of the superior mesenteric artery where these reach the mesenteric border of the jejunum. Whether actual traction on the bowel wall by these vessels is a factor in the initial diverticulum formation, or whether the diverticulum is pushed out by increased intestinal pressure along the channels made by these vessels through an abnormally weak longitudinal muscle coat, may be points for discussion, but there is no question that the blood-vessels are in some way directly related to their formation. The diverticula as they increase in size become very thin-walled. Finally their walls consist only of peritoneum and atrophic mucous membrane with a variable amount of intervening fat and here and there scattered remnants of the muscular coats of the bowel.

Complications are rare, for the diverticula occur mainly in the first three or four feet of the jejunum where the bowel contents are very fluid and relatively sterile. Moreover, though radiological examination may clearly define the diverticula by showing multiple fluid levels of retained bowel contents, and such retention may at times persist for several hours, it is probable that in the absence of kinking of the neck of the sac its wide opening into the bowel generally allows of emptying before the increase of organisms and pressure of gases produced by fermentation lead to the onset of inflammatory changes in the wall of the sac. Thus diverticulitis, with or without perforation, is a rare complication of a rare condition, but several cases have been recorded by Gordinier and Sampson, Ian Fraser, the writer, and others.

Traumatic perforation might be thought likely without the application of any very great force, for the walls of the larger diverticula become very thin and their distension by gas may be very marked, as indicated by X-ray examination and by the sensation of discomfort experienced by many of the patients. It seems, however, that no example of traumatic perforation of such diverticula has so far been recorded, and that it is therefore desirable to report the following case history.

A man aged 42, a carter, was admitted under my care to Addenbrooke's Hospital, Cambridge, with a history of having been kicked squarely in the abdomen by a cart mare four hours previously. Immediately after the accident he was faint and collapsed, but had

no great abdominal pain for more than an hour. He then commenced to vomit and began to complain of intense abdominal pain.

Upon arrival at hospital he was profoundly shocked, the pulse was rapid and poorly sustained, the abdominal wall was completely rigid, and the liver dullness had disappeared. On the abdominal wall a reddish ecchymosis already outlined on the skin the imprint of a large horseshoe placed approximately centrally about the umbilicus. A diagnosis of rupture of some hollow viscus was made and the abdomen opened by a right paramedian incision under gas and oxygen anæsthesia after infiltration of the abdominal wall with novocain.

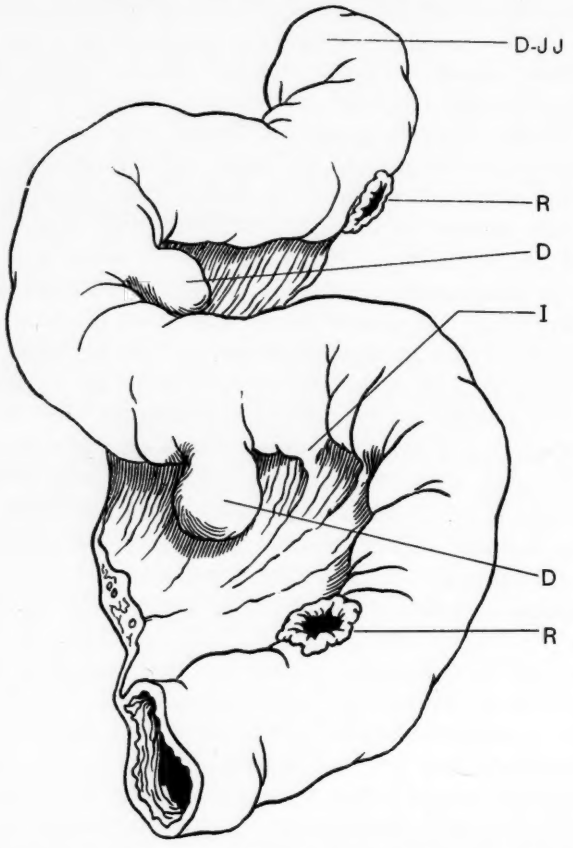


FIG. 200.—Semi-diagrammatic sketch of the first part of the jejunum showing the position of the diverticula. D-J J., Duodeno-jejunal junction; R, Ruptured diverticula; D, Intact diverticula; I, Incipient diverticulum. (× ½.)

Immediately upon opening the abdomen a coil of small intestine, which proved subsequently to be jejunum about fourteen inches from the upper end, presented itself, having on its right-hand side at the mesenteric border a large aperture with loose everted and pouting edges, from which bowel contents were escaping. The fluid which had already escaped from the perforation was confined mainly to an area to the right of the mesentery immediately around the perforation, and this area was quickly packed off and mopped dry and the perforation closed by one purse-string suture, further reinforced by another through the peritoneal coat which inverted and buried the first.

At this stage a diverticulum about one inch in diameter was found at the mesenteric border of the bowel on the right side of the mesentery about five inches above the perforation, and the true nature of the perforation as a ruptured diverticulum was apparent. The curious redundant margin of the perforation was, moreover, explained as the flaccid walls of the ruptured diverticulum falling back against the bowel wall.

A rapid survey was made for other diverticula, and another intact of similar size was found on the left side of the mesentery a further four inches towards the duodeno-jejunal juncture.

No diverticula of sufficient size to make these readily distinguishable in the fat of the mesentery were found distally, and there was no evidence of other perforations. The patient's condition was exceedingly poor and the abdomen was closed as rapidly as possible with drainage to the region of the perforation.

The patient's condition remained grave, abdominal rigidity and vomiting recurred, and in spite of all measures to combat shock and assist recovery he became gradually worse and died ten hours later.

At autopsy the abdomen was found to contain considerable quantities of fluid bowel contents, mainly towards the left side and down towards the pelvis. Tucked away behind the first part of the jejunum only about an inch and a half from the duodeno-jejunal junction was a second and much smaller perforated diverticulum—the presence of which had been missed at operation, and which had continued to leak into the peritoneum.

Probably at the time of operation traction upon the jejunum had kinked the bowel at this point, temporarily excluding the opening and still further hiding it by turning it away behind the bowel, and the gauze roll used to pack off the affected region of the peritoneal cavity may have helped to conceal it.

The site of this second perforation is an interesting example of the way in which the diverticula may occur at the very start of the jejunum, and the fact that the writer, who had previously been interested in such multiple diverticula, knew this already, only added to his disappointment that he should have missed finding the perforation at operation.

The semi-diagrammatic drawing of the specimen of the jejunum (*Fig.* 200) shows the position of the four diverticula, two of which were ruptured. Several incipient diverticula the size of small peas, but conical in form, with wide openings into the bowel, were present between these, and in the next few inches of jejunum below the lower perforation.

There was no history of previous dyspepsia—the patient having been a healthy farm worker who was said never to have had a day's illness.

REFERENCES

BUTLER, R. WEEDEN, *Brit. Jour. Surg.*, 1933, xxi, 329.
GORDINIER and SAMPSON, *Jour. Amer. Med. Assoc.*, 1906, xlvi, 1585.
FRASER, IAN, *Brit. Jour. Surg.*, 1933, xxi, 183.

USE OF THE ERECT POSITION IN CHOLECYSTOGRAPHY FOR THE DEMONSTRATION OF FLOATING GALL-STONES

By JAMES F. BRAILSFORD, Birmingham

In the routine cholecystographic examination it is advisable to take one or more of the serial radiographs with the patient in the erect position, for this will sometimes bring out features which may be unrevealed or unsuspected from the radiographs taken in the prone position.

In previous papers[1] radiographs were used which showed that in those patients whose gall-bladders contain stone or sand with relatively small quantities of calcium, the erect position will often cause the stones to collect together in the fundus, and the aggregation will suffice to cast a detectable shadow, though in the prone position, with the wider distribution of the foreign material, its shadow will be obscured by the general opacity of the dye-containing gall-bladder. With the modern tilting table and its incorporated Potter-Bucky diaphragm this technique can readily be followed as a routine procedure.

The case which prompted this communication presented unique radiographic appearances in the erect position which permitted an accurate diagnosis to be made. This is the more interesting because at a previous cholecystographic examination, which was conducted with the patient in a prone position for the radiographs, an inconclusive report only was possible from the evidence available. The cause of the indefinite evidence was the presence of numerous small non-opaque gall-stones which were suspended in the bile of the gall-bladder, and it was not until these were aggregated in the erect position that a definite shadow was cast. The unusual appearance produced by a collection of transparent gall-stones of like specific gravity suspended about midway in the depth of the gall-bladder suggested an artifact, but a further radiograph with the patient standing but leaning well to one side showed that the unusual shadow preserved its horizontal position when the spine of the patient was notably oblique. It was the demonstration of this feature which permitted me to diagnose that there was a collection of gall-stones floating in the gall-bladder.

The following is a brief summary of the case :—

The patient was referred to me on April 4, 1937, by Dr. Geoffrey Taylor. She was suffering with vague abdominal pains which led Dr. Taylor to suspect the gall-bladder. A previous cholecystographic examination had been made on Aug. 4, 1936, and the report given that " the gall-bladder filled. It is normal in size, shape, and position, and contracted normally after a meal. There are a few faint ill-defined shadows suspicious of non-opaque pigment stones within the gall-bladder, but no other abnormality could be detected."

Cholecystographs taken in the prone position again revealed the indefinite shadows within that of the gall-bladder (*Figs.* 201, 202), but in the erect position these arranged themselves into a horizontal zone of radiotransparency across the middle of the opaque gall-bladder (*Fig.* 203). The zone preserved its horizontal position when the patient leaned markedly to one side (*Fig.* 204). This enabled me to write the following report: " The gall-bladder filled normally. Its shadow is normal in size, shape, and position. Faint

FIGS. 201, 202.—Cholecystographs taken in the prone position.

FIG. 203.—Cholecystograph taken in the erect position.

FIG. 204.—Cholecystograph taken with the patient obliquely inclined from the erect position.

indefinite, rounded, transparent shadows are shown within. In the erect position these transparent bodies were arranged in a horizontal line, which was maintained with sloping of the body. I am of the opinion that these are a number of gall-stones actually floating in the bile."

I am indebted to Dr. Byam for a letter dated May 21, 1927, containing the following subsequent history :—

"The gall-bladder was removed on May 18 by Sir Thomas Dunhill. The following are the notes on the operation. Incision parallel with costal margin, obviously diseased gall-bladder removed. Cystic duct tore and three small stones escaped, but were retrieved. No evidence of disease of liver or pancreas, no involvements of lymphatic glands. Colon apparently healthy. Gall-bladder contained 86 small, smooth, circular stones which were hollow and floated on water. Closed with drainage.

"I examined the gall-bladder with the following result :—

"*Appearance.*—About 2½ in. long, distended with bile.

"*Contents.*—About 90 small gall-stones about the size of a millet seed, very light (float on water).

"*Cultures.*—Subperitoneal, mucus, and bile all sterile.

"If you would like to see some of the stones I should be pleased to send them. The fact that they are hollow would account for them floating on the surface of bile. Actually we find they float on the surface of water."

REFERENCES

[1] BRAILSFORD, JAMES F., "The X-ray Diagnosis of Pathological Conditions of the Gall-bladder", *Brit. Jour. Radiol.*, 1927, Feb.–March.; "Cholecystography", *Proc. Roy. Soc. Med.*, 1932, June, 27.

LAMBRINUDI'S OPERATION FOR DROP-FOOT

By F. P. FITZGERALD
REGISTRAR, ROYAL NATIONAL ORTHOPÆDIC HOSPITAL
AND H. J. SEDDON
RESIDENT SURGEON, COUNTRY BRANCH, STANMORE,
ROYAL NATIONAL ORTHOPÆDIC HOSPITAL

TEN years have elapsed since Lambrinudi (1927) described a novel and ingenious operation for drop-foot. The technique was subsequently simplified, and the operation as now performed generally follows the description given in a short paper published in 1932. In our opinion the time has come for a review of the results obtained from the operation, and an attempt to assess its particular merits and defects.

Only one surgical work, and that a very recent publication (1937), mentions the operation; and apparently only a few surgeons outside London are familiar with the procedure. Hence we think that, before discussing the results, a description of the operation as carried out nowadays is essential.

TECHNIQUE

The aim of Lambrinudi's operation is to use the natural bony obstruction to extreme plantar-flexion of the foot—namely, the posterior process of the astragalus—in such a way that dropping of the foot beyond a convenient position is not allowed.

The pre-operative planning of the planes of bone section is most important. One of us (H. J. S.), having carried out the procedure on six occasions, felt sufficiently confident to dispense with this preliminary, only to regret it afterwards, and it is worthy of note that Lambrinudi himself insists on it in every case. The actual steps are as follows:—

1. The amount of shortening must be known. A lateral radiograph of the foot in extreme plantar-flexion is taken, and a tracing made from the negative. The outlines of the os calcis, and of the remainder of the foot excluding the astragalus, are cut out, so that the tracing is in three pieces. Next, two horizontal lines are drawn on an ordinary sheet of paper, one representing the ground, and the other the height of the lift that will be necessary to compensate for the shortening. Clearly, it will be to the patient's advantage if the cork supplied after the operation can be made tapering to an edge at the tread, instead of being of uniform height from heel to tread, and the exact planes of bone section should be planned accordingly. *In any bone block procedure in the foot* this preliminary saves time, and contributes materially to the success of the operation. *Fig.* 205, A, is a tracing from an actual case. *Fig.* 205, B, shows the planes of bone section when the lift required is $1\frac{1}{4}$ in.; *Fig.* 205, C, the planes for the same foot made to lock at a few degrees below a right angle, that is, where no lift is required. It is clear from *Fig.* 205 that the smaller the drop to be permitted after operation, the greater

must be the amount of bone to be removed from the astragalus, and the smaller will be the 'beak' that interlocks with the scaphoid.

2. The preparation for operation, the position on the table, and the exposure of the tarsal bones in no way differ from the same steps in the ordinary triple arthrodesis. It is important that the foot below the astragalus should be completely dislocated medially before any joint surface is resected.

3. The astragalus is cut cleanly with a hand saw. This can only be done in the fully dislocated foot; the bone should not be shaped haphazardly merely to make an anterior spike. If, as in *Fig.* 205, C, it is found necessary to cut away

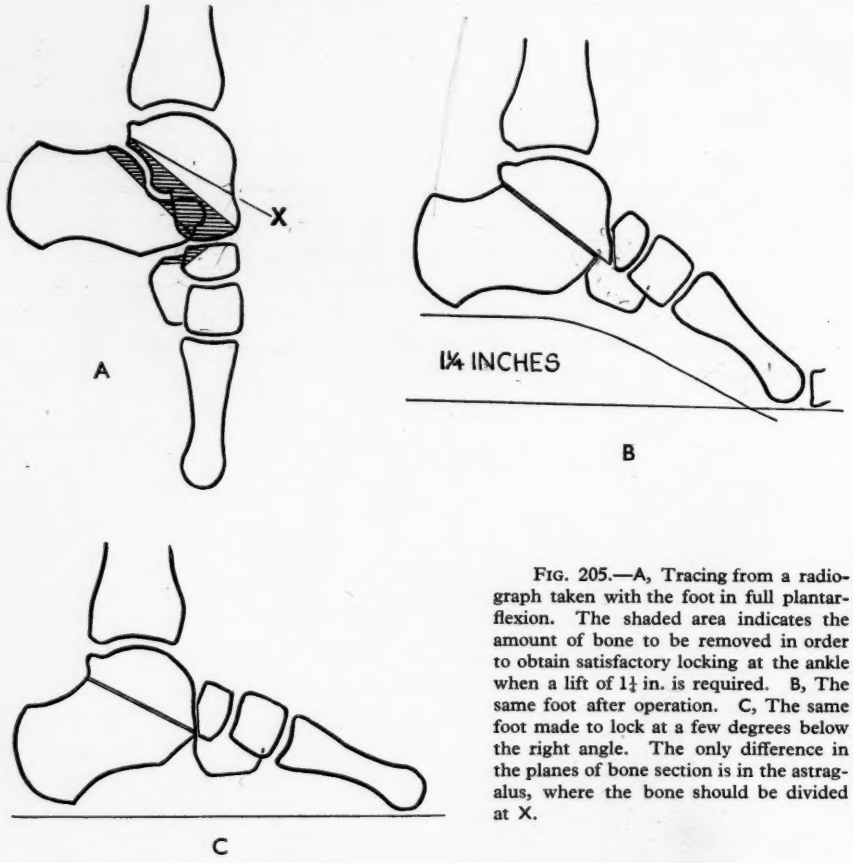


FIG. 205.—A, Tracing from a radiograph taken with the foot in full plantar-flexion. The shaded area indicates the amount of bone to be removed in order to obtain satisfactory locking at the ankle when a lift of 1¼ in. is required. B, The same foot after operation. C, The same foot made to lock at a few degrees below the right angle. The only difference in the planes of bone section is in the astragalus, where the bone should be divided at X.

much of the head of the astragalus, no apprehension need be felt for the security of the apposition of the components of the arthrodesis, provided that the planes of bone section have been planned correctly. The upper surface of the os calcis is cut with a broad osteotome, and a smaller one used for the calcaneo-cuboid joint and the notch in the scaphoid.

4. The cartilage that remains on the posterior surface of the scaphoid after the notch has been fashioned should not be removed, as this would weaken the upper margin of the slot.

5. When the cut surfaces fit satisfactorily, the 'beak' should be wedged firmly into the slot in the scaphoid and held in place while the incision is closed

and a short leg plaster applied. A lateral radiograph is taken soon after operation to confirm the position in plaster. After two weeks the plaster is cut, the stitches removed, remoulding carried out if necessary, and a closely fitting walking plaster applied. We have found that five months' fixation is required in most cases before firm fusion is obtained; this applies to all tarsal arthrodeses.

INDICATIONS FOR OPERATION

Some surgeons are of opinion that where stabilization of the paralytic foot is contemplated, the exact distribution of the paralysis in the leg may be ignored; others believe that paralyses of different distribution require individual treatment. Lambrinudi's operation is emphatically only for those in the second group. It is not a panacea: the indications for its employment are strictly limited.

The presence of a paralytic drop-foot, in itself, is not sufficient. The muscles of the thigh must be sufficiently strong to enable the patient to dispense with a full-length instrument. The surgeon should be able to say, before operation, exactly what benefit will be conferred by stabilization of the foot. If the patient is wearing a below-knee instrument with a toe-raising spring, he ought to be able to discard it after operation; if no instrument is worn, the high stepping gait of uncontrolled drop-foot should be corrected.

Lambrinudi insists that the calf muscle must be active—that is to say, the operation should not be performed on a flail foot. While we agree that the results of stabilization by his method are more satisfactory if the calf muscle is active, we do not consider this essential; eleven cases of flail foot have been operated upon (*see* table, pp. 290, 291), and the results are good except where lateral instability at the ankle-joint subsequently developed. This will be referred to later.

The operation should not be performed if a more constructive procedure can be employed. Drop-foot in association with active peronei is best dealt with by triple arthrodesis combined with transplantation of the peronei to the front of the foot. This operation can be relied on to restore active dorsiflexion. One of us (H. J. S.) has carried out this procedure on nine occasions during the past six years, with uniformly successful results. Among the cases reported in this paper will be found a number with active peronei that were dealt with by Lambrinudi's method. Although the results are satisfactory *qua* drop-foot, active dorsiflexion is still absent, and we mention these cases now only to dismiss them from the indications for Lambrinudi's operation.

The indications may be summarized as follows:—

1. The dorsiflexors of the foot and the peronei are paralysed.
2. The patient is able to control the knee without the assistance of a full-length instrument.
3. It is desirable that the calf muscle should be active, though this is not essential.
4. The patient should be sufficiently old. We prefer to wait until the age of 11 years or more, but there are surgeons who are prepared to perform arthrodesis of the foot in younger children, particularly when a deformity is present that cannot be controlled by an instrument: this is rarely the case with drop-foot or flail foot.

COMPARISON WITH OTHER METHODS

1. Astragalectomy, combined with posterior displacement of the foot, has long enjoyed a place of honour in the treatment of drop-foot. The operation was developed in America by Royal Whitman, and has been employed with success by a number of surgeons in this country, notably Laming Evans (1928). In spite of the excellent results that have been reported (and seen by one of us [H. J. S.] when working as an assistant to Laming Evans), we do not regard the operation with enthusiasm. It is unnecessarily destructive. If we destroy a normal joint, and that the very joint at which a certain amount of movement is desirable, when the same ultimate stability may be obtained by an operation which conserves the joint, then we are employing a relatively mutilating method. Astragalectomy increases the shortening, not a great deal, but enough to matter, and more than an operation in which the astragalus is preserved. Again, if an astragalectomy ' goes wrong ', and by this we mean the development of stiffness in the false joint or a painful arthritis, little or nothing can be done either to restore movement or to abolish pain: the condition of the foot may become irreparably unsatisfactory. Finally, the question of footwear. The posterior displacement of the foot, which is such an essential feature of Whitman's procedure, generally demands special boots or shoes, no ordinary footwear being capable of accommodating satisfactorily the very prominent heel. It may be objected that whatever stabilizing operation be performed special footwear will be required on account of the frequency of shortening of the whole limb or of the foot itself. Our answer is that a certain number of patients are able to wear ordinary boots or shoes after Lambrinudi's operation, but that we have never seen a case of astragalectomy in which this was possible.

2. Campbell's Operation (triple arthrodesis combined with a bone block—the excised scaphoid—planted in the os calcis behind the ankle-joint) is an attractive operation, but has its faults. One objection to it is that the block is anatomically foreign to the ankle, and we think it possible that the arthritis of the joint that has appeared in two of our cases operated on by this method is due to mechanical irritation produced by the presence of the block. In addition, the range of movement ultimately permitted by the block depends on the height and position of the block at the time of the operation and the completeness or otherwise of its subsequent regeneration as living bone; the latter is a factor over which we have no sure control. The operation, therefore, lacks the precision of Lambrinudi's, and it is more difficult to perform.

3. Triple Arthrodesis does nothing to limit the range of movement at the ankle-joint. In a flail foot the disability may, perhaps, be reduced if the foot is displaced well back (as in Dunn's operation) so that the centre of gravity of the foot comes to lie nearer to the axis of the ankle-joint.

Although we are convinced of the merits of Lambrinudi's operation, the results in the series of cases reported in this paper are not uniformly satisfactory. It is necessary, therefore, to inquire into the reasons for this, and we shall endeavour to show that the failures were due, not to any intrinsic defect in the operation, but to imperfect technique.

LATERAL INSTABILITY AT THE ANKLE

In 5 cases the result was marred by a most obvious lateral instability at the ankle-joint. In 4 this instability was so marked that a short iron with a T-strap was required to enable the patients to walk with confidence. They were, not unnaturally, disappointed, and one had to confess failure. The instability was demonstrated by grasping the foot, the patient being seated, and moving it from side to side. It was found that lateral movement at the ankle was permitted, chiefly eversion, and sometimes the joint actually rattled. In one case, on shaking the leg, the noise was audible at a distance of six feet.

The discovery of the cause of this unfortunate sequela seemed to us to be of paramount importance, since it accounted for failure of the operation in no less than one-fifth of our cases; for if lateral instability is sometimes unavoidable, it diminishes seriously the reliability of a most attractive operation. During the course of this investigation several explanations have been formulated, but we shall not weary the reader with a full account of them, as the most recent one is based on the actual findings on exploration of the ankle in one of the unsuccessful cases (*Case* 12), and explains all the observed facts.

Let us suppose that in cutting the slot beneath the scaphoid for the reception of the 'beak' of the astragalus insufficient bone has been removed medially; the slot, therefore, does not extend to the inner border of the scaphoid. The 'beak' of the astragalus is pushed into the slot, but instead of going well towards the medial border of the foot (*Fig.* 206, A), it is able to go only part of the way (*Fig.* 206, B). Fusion in this position is allowed to occur. Thus the patient is left with a foot that is rotated medially in relation to the ankle-joint, and there is a varus (supination) deformity of the foot beneath the astragalus. When walking is permitted the weight of the body will tend to strain the foot into the position it should occupy naturally. This is facilitated by the varus deformity which causes the outer border of the foot to make firmer contact with the ground than the inner. As the mid-tarsal and sub-astragaloid joints are fused, the strain can fall only on the internal lateral ligament of the ankle. The ligament, being entirely unsupported by active muscles, slowly stretches and the ankle-joint becomes unstable.

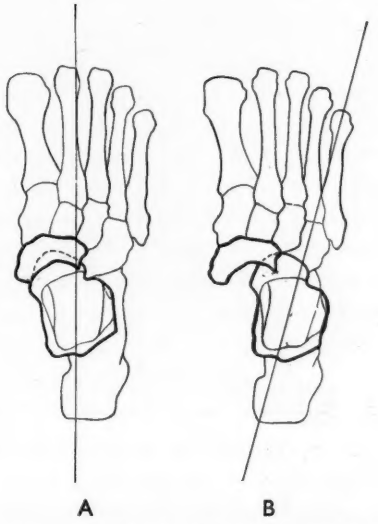


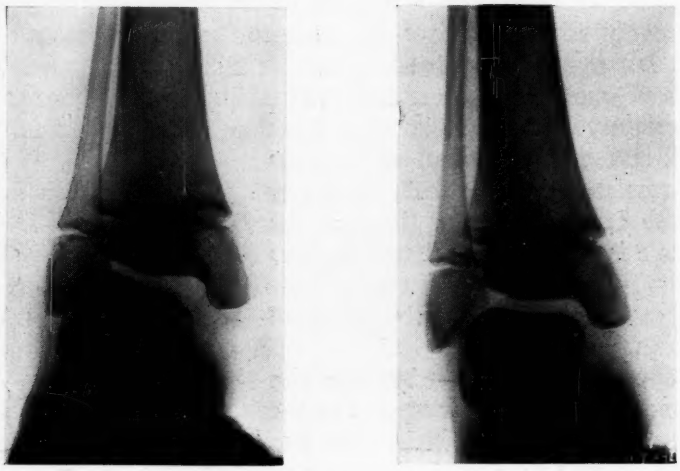
FIG. 206.—A, The beak of the astragalus has been placed correctly in the slot beneath the scaphoid. B, The beak of the astragalus is only partially beneath the scaphoid, with the result that the foot is internally rotated in relation to the leg.

The following observations suggest that this is the correct explanation:—

1. Exploration of the ankle in *Case* 12 showed the state of affairs described and illustrated in *Fig.* 206, B, although the deformity is exaggerated in the diagram. There was no disproportion between the astragalus and the mortice of the ankle, and the only defective structure was the internal lateral ligament, which was grossly lax. (It was interesting to observe that the cartilage on the anterior part of the

upper articular surface of the astragalus had disappeared completely from the area that had become non-articular as a result of the operation; also, the posterior bony block was well developed and covered with normal cartilage.) To remedy this defect the astragalus had to be removed and the foot displaced backwards (Whitman's procedure). It is too early to give a definite opinion on the result, but the child is beginning to walk and the foot promises to be stable.

2. Radiographic examination of the ankle in all five cases showed that the laxity was invariably on the inner side of the joint (*Fig.* 207).



A B

FIG. 207.—Lateral instability at the ankle (*Case* 24); in A the radiograph was taken with the foot forcibly everted; in B the foot was forcibly inverted. It is clear that the internal lateral ligament has stretched. The radiographic appearances in the other four cases were exactly the same.

3. It will be seen from the table that in three of the five cases of lateral instability a certain degree of varus deformity was observed. It was almost certainly due to the malposition of the astragalus already described.

4. The reason why lateral instability has not been observed following simple triple arthrodesis or Dunn's operation is that there is never any obstruction to the normal reposition of the astragalus during the final stage of the operation.

5. Lambrinudi has assured us that lateral instability at the ankle has not appeared in any of his cases, and this is not surprising. It is due to an error in technique not likely to be made by the originator of the operation. In this, as in other cases, mistakes are made by those who follow, not by the one who leads.

If the explanation given is correct, and we are convinced that it is, lateral instability at the ankle may be avoided by performing the operation exactly as described. It is fairly certain that Lambrinudi's operation has the merits he claims for it, and in our experience it may also be employed in the treatment of flail foot.

RESULTS

Twenty-four cases are reported (*see* table); 18 of them are a consecutive series operated on by one of us (H. J. S.) over a period of four years (1932–36), the remainder being some of the 21 cases operated on by Mr. Eric Lloyd during

the same period. We are indebted to him for allowing us to see his cases and to include them in this report. The cases are listed under three headings according to the extent of the paralysis in the leg, namely—calf muscle acting, flail foot, calf and peroneal muscles acting. No detailed reference will be made to the last group, as we are now of the opinion that Lambrinudi's operation is not the treatment of choice for paralytic drop-foot with active peronei. One partial failure in this group was due to lateral instability at the ankle.

In eight cases the calf muscle was active. There was one failure which emphasizes the importance of careful planning before operation: the ankle was locked too high, thus rendering the calf muscle almost impotent, the effect being almost the same as that of a triple arthrodesis plus arthrodesis of the ankle with the foot at a right angle. This could have been avoided by working out the planes of bone section before operation. The remaining cases were satisfactory.

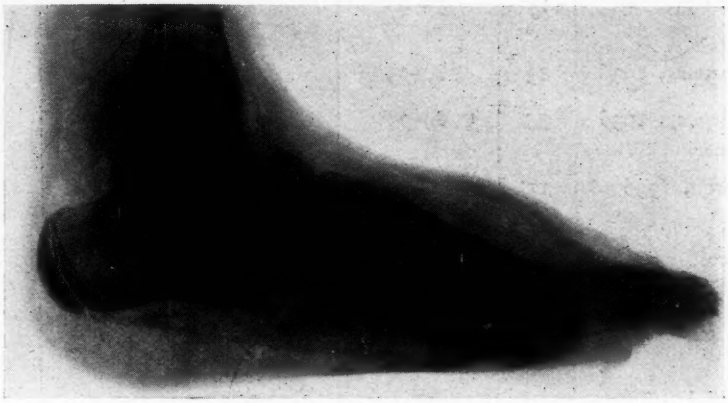


FIG. 208.—*Case* 8. Radiograph taken six months after operation.

Eleven flail feet were dealt with by Lambrinudi's method. Three failures and one partial failure were due to lateral instability at the ankle. The results in the remaining seven cases justify the performance of the operation for flail foot, although naturally the result is not always so satisfactory as when the calf muscle is active.

OTHER CONDITIONS

In conclusion, reference must be made to other conditions that have been dealt with successfully by Lambrinudi's operation.

1. Although all the patients in this series were the victims of acute anterior poliomyelitis, there is no reason why the operation should not be performed for paralysis of other origin. One of us (F. P. F.) has seen the operation employed with success by Mr. Eric Lloyd for an irrecoverable peroneal nerve injury.

2. The drop-foot of hemiplegia is the result of muscle imbalance, and is sometimes dealt with by tarsal arthrodesis. Stamm has employed Lambrinudi's operation in one such case: the result, seen by one of us (F. P. F.), although recent, is promising.

RESULTS IN 24 CASES TREATED BY LA

CASE NUMBER	DATE OF OPERATION	AGE AT OPERATION	RANGE OF MOVEMENT AFTER OPERATION*	LATERAL INSTABILITY AT ANKLE	TOTAL SHORTENING	RADIOGRAPHIC APPEARANCES
		Yr.			In.	
Calf Muscle Acting—						
1	October, 1932	12	120–135°		1¼	Satisfactory
2	December, 1933	14	75–115°		2½	Satisfactory
3	September, 1934	11	70–110°		2¾	Satisfactory
4	October, 1935	11	85–120°		1	Satisfactory
5	January, 1936	15	70–90°		1¾	Satisfactory
6	February, 1936	13	80–95°		None	Satisfactory
7	February, 1936	35	85–95°	+	2	Satisfactory
8	March, 1936	11	85–105°		2½	Satisfactory
Flail Feet—						
9	April, 1932	15	75–125°		1½	Satisfactory
10	April, 1932	14	90–140°		2¼	Satisfactory
11	June, 1932	10	90–135°	+ + + +	1½	Satisfactory
12	June, 1933	13	85–120°	+ + +	2	Satisfactory
13	June, 1933	12	85–130°		1½	Satisfactory
14	June, 1934	13	85–115°	+ +	2¾	Satisfactory
15	July, 1934	12	90–135°	+ + +	3	Satisfactory
16	July, 1934	14	85–100°		1½	Satisfactory
17	August, 1934	14	80–100°		1¾	Satisfactory
18	October, 1934	14	85–110°		1¼	Satisfactory
19	November, 1934	12	90–130°		1¾	Satisfactory
Calf and Peroneal Muscles Acting—						
20	June, 1933	16	90–120°		2	Satisfactory
21	August, 1934	13	85–120°		1	Satisfactory
22	October, 1934	16	90–110°		None	Satisfactory
23	September, 1935	12	90–100°		Not known	Os calcis lies slightly medial to astragalus
24	April, 1936	10	80–110°	+ + +	1½	Satisfactory

* The neutral position at the ankle is reckoned as 90° : dorsiflexion 90°→0° : plantar-flexion 90°→180°.

LAMBRINUDI'S OPERATION FOR DROP-FOOT

DEFORMITY (POST-OPERATIVE)	CLINICAL CONDITION BEFORE OPERATION	CLINICAL CONDITION AFTER OPERATION†	SUCCESS OR FAILURE
None	Caliper	Walks 4 miles. No trouble on rough ground. 30° flexion deformity of knee which ought to be corrected	Success
None	Short instrument : toe-raising spring	At work, " on his feet all day."	Success
Slight varus of heel and dropping of forefoot	Short instrument	Walks with a little uncertainty on account of weakness of quadriceps	Success
None	Drop-foot gait	Walks 4 miles with ease	Success
Very slight pes valgus	Short instrument	Walks badly on account of severe lordosis. Ankle locked too high. Calf muscle now useless	Failure
None	Short instrument : toe-raising spring	Walks well	Success
None	Short instrument	Not yet walking well. Other limb affected and foot stabilized by Dunn's method	?
None	Short instrument : uncontrollable equino-varus deformity	Walks well	Success, (*Fig.* 208)
None	Short instrument : toe-raising spring	Cycles 6 miles every day : local tennis champion	Success
Slight cavus ; 140° drop —a little excessive	Short instrument : toe-raising spring	Walks miles	Success
None	Caliper	Instrument necessary to control lateral instability of foot	Failure
Slight varus of whole foot	Short instrument : toe-raising spring	Instrument necessary to control lateral instability of foot	Failure
None	Short instrument	Walks miles	Success
Slight equino-varus	Short instrument	Instrument necessary to control lateral instability of foot	Failure
Very slight varus	Caliper	Foot feels weak	Partial failure
None	Caliper	Walks well in spite of flail knee	Success
None	Short instrument	Walks well. Cycles 2 miles with ease	Success
Slight metatarsal varus	Caliper	Cycles and swims, but wears caliper for long walks on account of weak quadriceps	Success
None	Short instrument	Sprains foot occasionally, otherwise good	Success
None	Short instrument	Walks 3 miles with ease	Success
None	Short instrument	Can walk " many miles "	Success
Very slight equino-varus	? Drop-foot gait	Can walk 10 miles	Success
Varus at heel (*see Fig.* 207)	Drop-foot gait	Walks 4 miles with ease	Success
None apart from deformity of great toe	Short instrument	Can walk 2 miles : leather cuff necessary to control ankle	Partial failure

† Unless otherwise stated, the patient is able to walk without an instrument.

3. In old imperfectly corrected club foot, one of the most formidable barriers to complete correction by open operation is the excessive breadth of the anterior part of the upper articular surface of the astragalus. If an elongation of the Achilles tendon and a posterior division of the capsule of the ankle are performed with a view to correcting a fixed equinus deformity, it is found only too often that the astragalus refuses to tilt back into its normal position because it is too broad anteriorly. Lambrinudi's operation is the obvious solution of the problem. The astragalus is left where it is and the remainder of the foot brought up to it. We have used the operation in this way on one occasion with complete success.

SUMMARY

Lambrinudi's operation for drop-foot is a simple and effective procedure. A successful result depends largely on the pre-operative planning of the planes of bone section: this is done from a tracing made from a lateral radiograph of the foot in full plantar-flexion.

The operation is also of value in the treatment of flail foot.

Five failures in a series of twenty-four cases were due to lateral instability at the ankle. This is the result of an error in technique and is avoidable.

REFERENCES

BURNS, B. H., and ELLIS, V. H., *Recent Advances in Orthopædic Surgery*, 1937, 252. London: J. & A. Churchill.

EVANS, E. LAMING, Robert Jones Birthday Volume, 1928, 375. London: Oxford Medical Publications.

LAMBRINUDI, C., *Brit. Jour. Surg.*, 1927, xv, 193.

LAMBRINUDI, C., *Proc. Roy. Soc. Med.*, 1932, xxvi, 788.

DERMOID AND ALLIED CYSTS OF THE KIDNEY

By J. COSBIE ROSS

HONORARY ASSISTANT SURGEON, LIVERPOOL ROYAL INFIRMARY

A STUDY of the recorded cases of so-called dermoid cyst of the kidney reveals that not only is this an extremely rare condition, but also that the collection of cases can be readily divided into two clearly distinguishable groups. Those in the first group can be positively identified as dermoid on account of the presence of hair, squamous epithelial lining, etc. In the other group fall those cases having many of the macroscopic attributes of the dermoid, but lacking complete proof as to their origin. The following case appears to fall into this second group.

CASE RECORD

A male, aged 39, was admitted to hospital complaining that during the previous two years he had had attacks of pain which commenced in the right loin and radiated to the groin. Although the pain was generally of a mild character, on occasion short periods of severe renal colic were experienced. His other symptoms included occasional dysuria and slight diurnal frequency. A previous urological investigation had been carried out at another hospital, where a diagnosis of right renal calculus had been made and operation suggested. The patient however, had refused operation and been discharged *in statu quo*.

CLINICAL EXAMINATION.—Slight tenderness was present in the right loin, but the kidney was not palpable. Urinary analysis revealed a trace of albumin, and on microscopical examination a few pus cells and red blood-corpuscles were found.

The X-ray findings were as follows :—

1. Simple radiograph of the urinary tract: "Several shadows in the right renal area suspicious of renal calculi."

2. An intravenous pyelogram was carried out and reported on as follows: "Several small calculi in the pelvis of the right kidney; the left kidney excretes the dye normally. Poor filling of the right renal pelvis."

The non-protein nitrogen equalled 38 mg. per cent.

A cystoscopy was performed under low spinal anæsthesia, the bladder being of normal appearance and capacity. After intravenous injection of 10 c.c. of 0·4 per cent indigo-carmine, the dye was excreted on the left side within 3 minutes and on the right within 4½ minutes of injection. The ureteric orifices were normal in every respect.

DIAGNOSIS.—In view of the above findings, a diagnosis of right renal calculi was made and operation suggested.

OPERATIVE FINDINGS.—The right kidney was delivered through a curved lumbar incision, and found to be normal in appearance with the exception of a rounded cystic swelling, yellowish-white in colour, situated partly in the substance of the kidney and partly projecting from its anterior surface (*Fig.* 209). Calcareous plaques could be readily detected in the wall of the cyst, which was oval in shape, being 1½ in. in length and 1 in. in diameter. The cyst lay in the radial axis of the kidney, one rounded extremity encroaching on the hilum. Turbid yellow fluid containing flakes of white debris was aspirated to render the cyst less tense, and the cyst was then enucleated, separating readily from the underlying cortex, which appeared normal. To do this the renal capsule was divided in a circular manner at the periphery of the cyst as the situation of the cyst was subcapsular. Bleeding was severe, but was controlled by obliterating the resulting cavity with mattress sutures over strips of muscle

obtained from the external oblique. A drainage-tube was placed on the anterior aspect of the kidney, and the wound closed.

AFTER-HISTORY.—Convalescence was uneventful, and he was discharged from hospital three weeks later symptom-free.

(It will be seen how close a resemblance there is between the above case and that described by Valentine,[1] especially as in these two cases only was successful enucleation of the cyst carried out without removal of the kidney.)

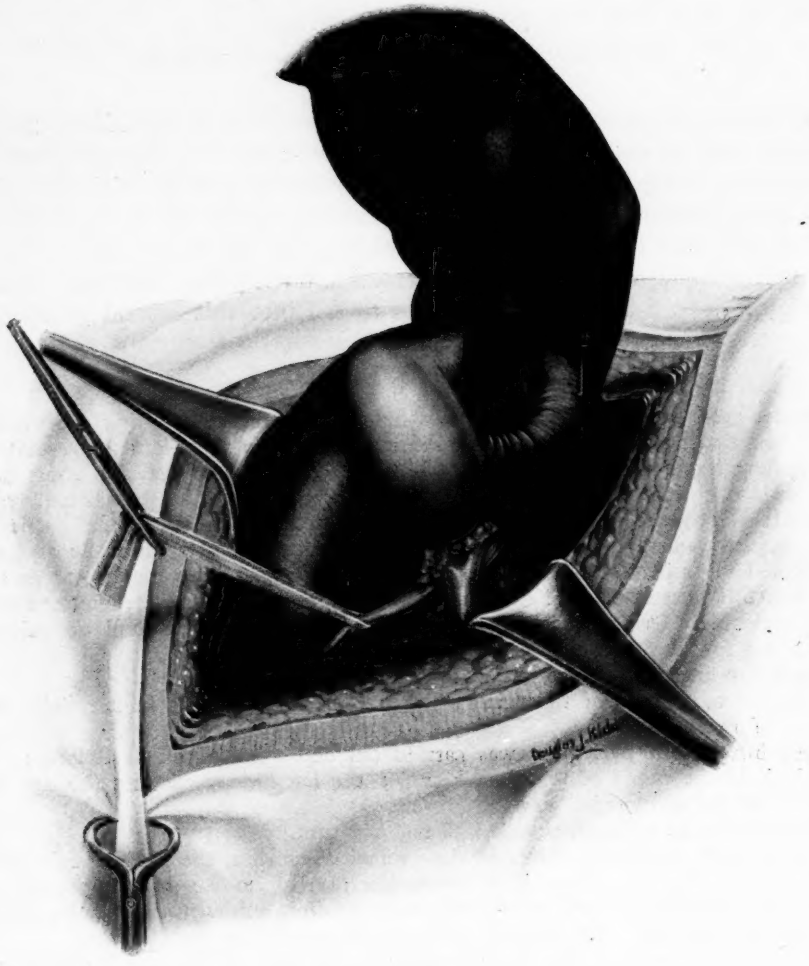


FIG. 209.—The kidney and cyst as seen at operation.

PATHOLOGY.—The late Dr. H. A. Osborn, who examined the cyst for me, kindly made the following comments with regard to the pathological findings: "The present cyst falls into the second group of doubtful aetiology. The cyst wall is composed of fibrous tissue which gradually gives way on the outer side to sclerosed kidney substance. On the inner side the tissue is necrotic and it is therefore impossible to be dogmatic, but it has some resemblance to kidney tissue and suggests that in the past there may have been some upset in the blood-supply and the ischæmic area was too large to form a simple scar, and that the cyst represents a degeneration of the necrotic tissue. The absence of blood pigment suggests that this took place many years ago, but it is impossible to give any indication of the probable

cause. The cyst contained pultaceous matter, cholesterol crystals, and fat globules. The pathological report by Valentine practically describes the present specimen. Valentine states that the wall was composed of dense strands of hyaline tissue, while on the inner surface there was a loose areolar structure in which there were many blood-vessels, some of which had rather thin walls, but much thickened in others. It was also infiltrated with numerous inflammatory cells, and no lining epithelium was observed. Valentine was of the opinion that his was a true renal dermoid.

"Losee studied his specimen for Valentine, and stated that, regardless of the fact that no squamous epithelium was observed in the cyst, the diagnosis can be made from the contents. Again, Losee quotes Ewing that epidermal rests derived from the Wolffian duct are probably the source of certain dermoids of the kidney, and that they contain no dermal glands. It is doubtful whether the present cyst is a dermoid, but it would undoubtedly have been classified as such by Losee. The absence of any epidermal elements is rather a difficult matter to explain away, and the fact that it was subcapsular is another point against the diagnosis, as the other true dermoids were not subcapsular. This cyst was very vascular on the outer side, and congestion may well be the explanation of the lumbar pain. There was also well-marked hyaline degeneration of the fibrous tissue, and a small round-celled infiltration round the cyst with congestion and œdema."

DISCUSSION

A tabulated list of the 14 reported cases is given below, and an attempt has been made in the table to divide these into: *Group* 1—authentic dermoid cysts; and *Group* 2—what might be called paradermoids.

A third group may be added of dermoid cysts in the vicinity of the kidney, and a list of these is given by Williams,[2] who mentions the following:—

1. RUGE.—A cyst close to the outer side of the kidney. In this large cyst two compartments were present, one of which was lined by skin and dermal glands, while the other reproduced intestinal mucosa. Ruge considered this cyst to be arising from a remnant of the vitelline duct.

2. ZWEIFEL.—A cyst intimately connected with the upper pole of the left kidney and displacing the pelvis.

3. CZERNY.—A retroperitoneal paranephritic dermoid cyst intimately blended with the capsule of the kidney.

4. EHLER.—A conglomerate mass consisting of four dermoid cysts situated over the hilum of the left kidney.

This third group may be classified as retroperitoneal dermoid cysts rather than renal.

The famous dermoid cyst described by Paget,[3] although frequently quoted, was not of human origin.

A study of the table does not reveal many characteristic features or common attributes likely to be helpful in making the diagnosis.

It is interesting that nearly all cases suffered from backache or renal colic of varying degree of severity, and that many cases, contrary to expectation, complained of dysuria, frequency of micturition, and hæmaturia. A correct pre-operative diagnosis has never yet been made. A possibly important feature is that the calcification present both in Valentine's case and that of the author led to a pre-operative diagnosis of renal calculi.

With regard to the operative treatment adopted, nephrectomy with removal of the cyst was carried out in seven cases, with one death. Three cases, which subsequently died, were marsupialized, and in another a renal sinus was scraped.

TABLE OF REPORTED DERMOID

REPORTER	URINE	AGE	SEX	LENGTH OF HISTORY	LUMBAR PAIN	URINARY SYMPTOMS
Group 1.—						
1. Goldsmith[6] ..	Not mentioned	26	M	18 years	1. Dull ache 2. Attacks of colic	Hæmaturia
2. Walker[7] ..	Normal	11	F	1 year	1. Backache 2. Colic	"Irritable bladder"
3. Boni[8]	Slight albuminuria; numerous transitional epithelial cells	45	F	15 years	Colic	? Hæmaturia
4. Bardenheuer[9] ..	Blood	17	F	1 year	Lumbar pain	? Hæmaturia
5. Haekel[10] ..	Not mentioned	58	F	1 year	Lumbar pain	None
6. Fahri[11] ..	Trace of albumin; few pus cells; blood	69	F	1 year	Mild colic	Hæmaturia
7. Thomson-Walker[12]	Normal	—	—	—	—	—
Group 2.—						
8. Rider-Thompson[13]	Normal	45	M	2 years	1. Backache 2. Mild colic	Hæmaturia and frequency
9. Baldwin[14] ..	—	16	F	Many years	None	None
10. Schlegtendal and Madeling[15]	—	22	M	Many years	None	None
11. Wyss[16] ..	Albumin; pus cells; blood-casts	37	F	25 years	Yes	Hæmaturia; dysuria; nocturia; frequency
12. Jeanbrau and Truc[17]	Normal	Adult	F	1 month	Backache	None
13. Valentine[18] ..	Pus, blood, *B. coli*	46	F	Several years	Backache	Frequency; dysuria; pyuria; hæmaturia
14. Personal case ..	Trace of blood, pus, and transitional epithelium	39	M	2 years	1. Backache 2. Mild colic	Frequency; dysuria

AND PARADERMOID CYSTS

PALPABLE MASS	PRE-OPERATIVE DIAGNOSIS	OPERATION	RESULT	PATHOLOGY
Yes	Floating kidney	Nephrectomy with removal of cyst	Cured	Cyst at upper pole containing hair, teeth; lined by squamous epithelium
Yes	—	Nephrectomy with removal of cyst	Cured	Three cysts containing fat and hair; epithelial cells and embryonal connective tissue
Yes	Hydronephrosis; ? renal calculi	Removal of cyst with kidney	Died	Five cysts containing yellowish fluid; hair and hair follicles found and squamous epithelium
Yes	? Omental tumour; ? swelling of floating kidney	1. Drainage 2. (Later) partial removal	Died	Fat and hair; bony fragments and teeth
Yes	—	Nephrectomy with removal of cyst	Cured	Pultaceous yellow matter and hair
Yes	Pyonephrosis	Nephrectomy with removal of cyst	Cured	Cyst containing yellow tallowy contents and lined by keratinized epithelium with warty patches; secondary pyonephrosis and stone formation
Sinus and scarring	Renal sinus	Scraping of sinus	Cured	Hair; pultaceous matter and squamous epithelium
Yes	—	Aspiration and marsupialization of sac	Died	Huge sac full of pultaceous matter, small pieces of bone, and nodular masses in wall; nodular masses "columnar-celled carcinoma"
Yes	Ovarian dermoid	Nephrectomy with removal of cyst	Cured	Cyst with bony plaques in walls, containing turbid fluid and cholesterol crystals—no hair
Yes	Hydatid cyst of liver	Cyst marsupialized	Died	Cyst full of pultaceous matter, fat cells, and cholesterol crystals; calcified areas; ? epidermis
Yes	Malignant tumour arising in an aberrant kidney	Nephrectomy with removal of cyst	Cured	Cyst with ossified walls replacing kidney; cyst containing cholesterin, pultaceous matter, fat, ? epithelium
Yes	Tumour in left hypochondrium	Aspiration and resection of cyst	Died	Large bluish renal cyst containing fibrinous and caseous material
No	Renal calculi (X-ray report)	Aspiration and resection of cyst	Cured	Cyst containing fat globules, cholesterin crystals, cheesy material; no hair or epithelium
No	Renal calculi (X-ray report)	Aspiration and resection of cyst	Cured	Cyst containing fat globules, cholesterin crystals, cheesy material; no hair; no epithelium

In three cases the cyst was removed without carrying out a nephrectomy, and two of these were successful.

The origin of the seven cysts in the second group raises several interesting questions.

Are these cysts to be regarded, as Dr. Osborn contended, as originally of hæmorrhagic origin? In connection with hæmorrhagic cysts of the kidney, Hinman,[4] while giving his opinion that the majority of them result from hæmorrhage into a solitary serous cyst, adds that many hæmorrhagic cysts cannot be so explained. He also quotes Begg as saying that some are aneurysmal in origin.

Ewing[5] gives the following definition: "The simple dermoid consists of epidermis, derma, and dermal glands, and usually appears in the form of a cyst. In the epidermoid, definite dermal structures are missing." He goes on to say that while many epidermoid cysts are of traumatic origin, some well-defined forms are of embryonic derivation and produce characteristic tumours, such as cholesteatoma. Ewing considers dermoids of the kidney to be due to epidermal rests derived from the Wolffian duct, and states that they contain no dermal glands. He quotes Schlegtendal's case (*Group* 2) as an example of a renal dermoid, and, if this authority be accepted, these doubtful cases, including the author's, may be similarly regarded.

SUMMARY

A case of renal cyst, of possibly dermoid origin, is described. The recorded cases are analysed, and an attempt is made to divide these into two clearly defined groups—i.e., those of definite dermoid origin, and those having many of the attributes of a dermoid cyst without having the presence of characteristic structures such as hair, squamous epithelium, etc. Mention is made of a third group of retroperitoneal dermoid cysts.

REFERENCES

[1] VALENTINE, *Amer. Jour. Surg.*, 1929, vi, 93.
[2] WILLIAMS, *Lancet*, 1913, i, 561.
[3] PAGET, *Surgical Pathology*, 1853. Longmans.
[4] HINMAN, *Principles and Practice of Urology*, 1935, 1048. Saunders.
[5] EWING, *Neoplastic Diseases*, 3rd ed, 1928, 1032. Saunders.
[6] GOLDSMITH, *Surg. Gynecol and Obst.*, No. 8, 400.
[7] WALKER, *Trans. Amer. Surg. Assoc.*, 1897, xv, 591.
[8] BONI, *L'Ospedale maggiore*, 1906, i, 386.
[9] BARDENHEUER, *Der extraperitoneale Explorativschnitt*, 1887, 680.
[10] HAEKEL, *Berlin klin. Woch.*, 1902, xxxix, 964.
[11] FAHRI, *Deut. Zeits. f. Chir.*, 1934, ccxliii, 629.
[12] THOMSON-WALKER, *Genito-Urinary Surgery*, 2nd ed., 222.
[13] RIDER-THOMPSON(ALONZO RIDER), *Lancet*, 1906, ii, 1589.
[14] BALDWIN, *Surg. Gynecol. and Obst.*, 1915, xx, 219.
[15] SCHLEGTENDAL and MADELING, *Arch. f. klin. Chir.*, 1887, xxxvi, 304.
[16] WYSS, *Beitr. z. klin. Chir.*, 1902, xxxii, 122.
[17] JEANBRAU and TRUC, *Arch. Soc. des Sci. méd. de Montpellier*, 1932–33, xiv, 439.

THE SUPERVENTION OF OSTEOGENIC SARCOMA IN PAGET'S DISEASE

By T. B. DAVIE

PROFESSOR OF PATHOLOGY, UNIVERSITY OF BRISTOL

AND W. E. COOKE

DIRECTOR OF PATHOLOGY, WIGAN ROYAL INFIRMARY

SINCE Paget first described the disease of bones now known by his name or as osteitis deformans, its association with malignant disease, and more particularly with the development of sarcoma, in one or more of the affected bones has always excited interest and provoked discussion. In recent times this subject has received added attention by reason of the more intensive study of the pathology of bone lesions in general consequent upon the development and rapid growth of orthopædics and bone surgery. For this reason the two following cases are considered worthy of consideration, more particularly as some special features presented by them may throw some light on the many problems of Paget's sarcoma.

CASE REPORTS

Case 1.—S. B., a married woman of 64, had suffered for four years from 'rheumatic pains', and had observed a gradual decrease in her stature during the last three years. Six months before admission to hospital she noticed that two small lumps which had appeared

FIG. 210.—*Case* 1. Right humerus at time of spontaneous fracture, showing large tumour shadow and commencing erosions by small tumours in lower extremity of humerus.

FIG. 211.—*Case* 1. Same humerus as in *Fig.* 210 about two months later, showing enlargement of tumour foci in bone.

under the scalp in the right parietal region were growing rapidly larger. Three months later she fractured her right humerus whilst turning a mattress (*Fig.* 210). Further radiological examination at a later stage showed typical Paget's disease changes in the fractured humerus

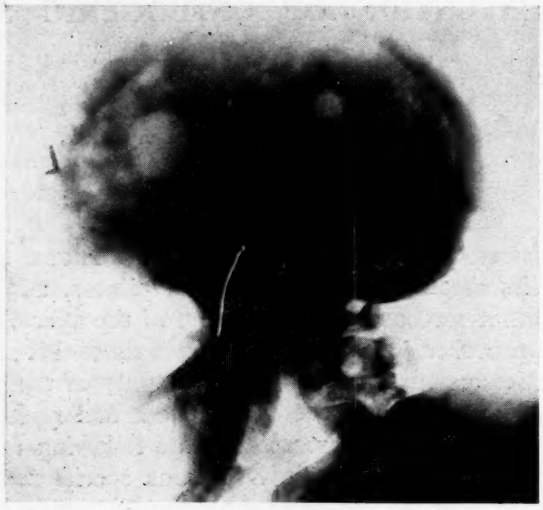


FIG. 212.—*Case* 1. Skull one month before death, showing typical Paget's changes and numerous rounded tumour areas.

FIG. 213.—*Case* 1. Two portions of calvarium at time of autopsy, showing typical thickening of Paget's disease and one large tumour mass involving whole thickness of skull and protruding inwards.

and also in the skull and other bones (*Figs.* 211, 212). In these radiographs appeared many punched-out areas, diagnosed by the radiologist as due either to sarcomatous change in the Paget's bones or to carcinoma metastases from an undetermined primary growth. No blood-chemistry examinations were made, and she died three months later.

POST-MORTEM FINDINGS.—The thoracic and abdominal organs showed no evidence of disease; in particular, there was no evidence of primary or secondary malignant growth. The skull showed the typical thickening and marbling of Paget's disease, and in several places the bone had been completely destroyed by fleshy growths which projected as large swellings under the scalp and also within the skull, pressing upon the brain through the dura mater (*Figs.* 213, 214). At the site of fracture in the right humerus a similar fleshy tumour occupied the region of the fracture and infiltrated the surrounding muscles. At various places on the surface of the shaft of the bone could be seen small circular tumour masses from 2 or 3 mm. to 1 cm. in diameter. These were only slightly raised above the surface, but could be scooped out, leaving hemispherical beds of softened bone. The pituitary gland appeared normal. The thyroid was firm and noticeably paler than normal, and there was no macroscopic enlargement of the parathyroids. The medium-sized arteries showed medial calcification and the kidneys showed arteriosclerotic changes.

FIG. 214.—*Case* 1. External aspect of portion of calvarium, showing two of the largest sarcoma masses projecting from the surface under the scalp.

Histological Examination.—Sections of the large tumour masses of the skull and from the site of pathological fracture of the humerus all show a spindle-cell sarcoma (*Fig.* 215). No bony spicules were observed in the sections examined, and there is no evidence of neoplastic new bone formation. Several of the smaller tumour masses referred to above were scraped out from the humerus for histological examination. A few of these showed the same spindle-cell sarcoma structure of the larger growths, but most of them presented a less malignant looking picture with a cellular stroma in which were numerous giant cells (*Fig.* 216). These bear no resemblance to malignant giant cells, but are in fact typically the osteoclastomatous type of giant cell seen in benign giant-cell tumours of bone. These small tumours do in fact occasionally resemble benign osteoclastomata rather than sarcomata. The bones near the sites of malignant change showed advanced Paget's disease, with typical vascular cellular connective and granulation tissue occupying the intertrabecular spaces in the bone. Osteoclasts were, as usual, not numerous, though in the immediate neighbourhood of the malignant masses there were more of these cells than is usual in uncomplicated Paget's disease.

Sections of the thyroid gland showed a most unusual picture characterized by an apparent excessive cellularity. This, on examination, proved to be the result of the great

reduction in, and even the complete absence of, colloid from the vesicles, with consequent collapse (*Fig.* 217). This unusual picture was not confined to localized areas, but was found in all parts of the gland. In places the absence of vesicle formation was so complete that the closely packed pale epithelial cells, with little intervening stroma, closely resembled the

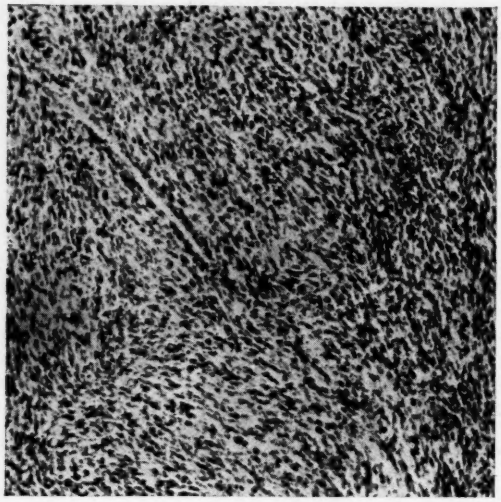


FIG. 215.—*Case* 1. Microscopical appearance of one of the scalp tumours, showing the typical structure of spindle-cell sarcoma. (× 60.)

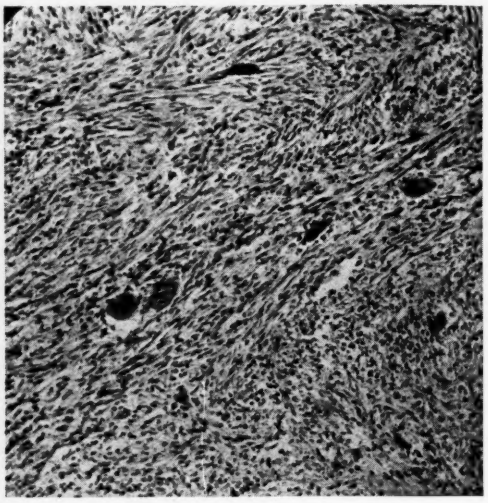


FIG. 216.—*Case* 1. Microscopical structure of one of the smaller tumours excavated from the surface of the humerus, showing a number of osteoclastomatous giant cells in a stroma resembling the sarcoma structure of the larger tumours, but less malignant in appearance. (× 60.)

FIG. 217.—*Case* 1. Section of the thyroid gland, showing apparent absence of vesicles, giving a general appearance reminiscent of parathyroid. The medial calcification of the branches of the thyroidal arteries can also be seen. (× 60.)

picture of a normal parathyroid gland. Although the parathyroid glands were not isolated, a small portion of one of them was found included in one of the sections of the thyroid. It showed only one feature of note, namely, the almost complete absence of oxyphil cells. The

intraglandular branches of the thyroid arteries showed pronounced medial calcification even in the smaller branches (*Fig.* 217).

Case 2.—K. J., a man aged 42, had complained of pain in his legs for four years. Three months before his death the left leg became weak, and X-ray examination revealed Paget's disease of the spine and a subluxation of the 2nd lumbar vertebra. A tentative diagnosis of malignant disease in the 1st and 2nd lumbar vertebræ posteriorly was made. The weakness of the left leg progressed to a complete paraplegia in six weeks, and at this stage X-ray examination was repeated. This revealed further destruction of the 2nd lumbar vertebra by a growth, diagnosed as a sarcoma, spreading in the perivertebral soft tissues on the left. At the same time examination of the right forearm, where a palpable swelling had appeared, showed advanced Paget's disease in both bones, with a localized area of rarefaction in the upper portion of the ulna. There was commencing ossification in the soft tissues, but no periosteal reaction. These changes were regarded as also probably due to sarcomatous

FIG. 218.—*Case* 2. Radiograph of excised lumbar vertebræ with growth attached. The degree of ossification within the sarcoma is evidenced by the intensity of its X-ray shadow, and the necrotic cystic condition of the *lower part* is well shown.

change. A fortnight later a lump appeared on his head. X-ray examination showed the characteristic picture of Paget's disease of the skull but no typical diagnostic signs of malignancy. He lived for another month, during which time the compression paraplegia was complicated by cystitis and pyelitis, and the cerebrospinal fluid showed the classical characteristics of a Froin's loculation syndrome. Extreme emaciation and multiple and extensive bedsores were features of the last stages.

POST-MORTEM FINDINGS.—In the thorax the only lesions consisted of several flattened pearly tumour nodules attached to the pleural surfaces on the right side. The largest of these on cutting was found to contain bony spicules. In the abdomen the liver showed advanced toxic fatty change and the spleen was of the 'septicæmic' type. The bladder showed acute hæmorrhagic cystitis, and both kidneys showed suppurative pyelitis. No malignant metastases were found within the abdomen. The endocrine glands were all examined and showed no abnormality of size or structure. The brain and cord were free from metastases, but the latter was compressed at the level of the 1st lumbar vertebra.

The skeletal system showed widespread involvement by the changes of Paget's disease, with the addition of multiple foci of malignant disease. The largest and apparently the earliest of these sarcoma masses was a large infected fleshy mass attached to the left side of the lumbar vertebræ. It measured 9 × 6 × 5 in., and consisted of yellowish tissue which in its uppermost portions contained much new bone formation, while its lower portion was largely occupied by an infected necrotic cyst. The laminæ of the 1st, 2nd, and 3rd lumbar vertebræ were eroded, and the spinal canal was invaded by growth which compressed the lower end of the cord and the cauda strands; the radiograph (*Fig.* 218) of this region excised at autopsy shows the size and location of the growth. Both ulnæ were thickened and bowed. To the periosteum of the right ulna at the junction of its upper and middle thirds was attached a yellowish-grey rubbery tumour of about 2 in. diameter. A similar but smaller mass lay alongside of it between the muscle planes. Both femora were irregularly thickened, and on the right side a tumour closely resembling those described above was found growing from the periosteum of the upper third of the shaft. The tibiæ showed similar Paget's disease changes, and here, as in the femora, the thickening of the bone encroached on the marrow cavity. The 6th rib on the right side showed a pathological fracture one inch from the costo-chondral junction, the site of the break being occupied by a creamy tumour. In the skull three distinct tumours were located. The first was large and firm and grew from the pericranium in the right occipital region. The second was small and situated within the skull near the mid-point of the vault. This tumour was soft in consistency. The third tumour grew from the under

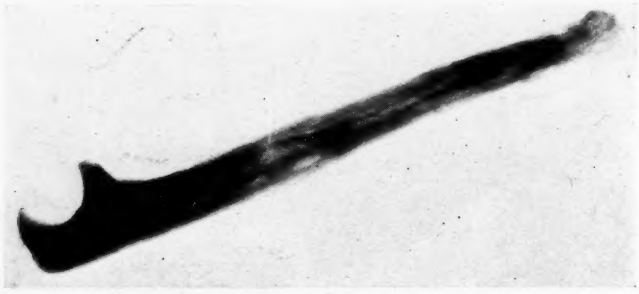


FIG. 219.—*Case* 2. Radiograph of dissected right ulna, showing rarefaction of bone in the region of attachment of the large periosteal growth, and at the lower end several small erosions in the bone indicating the sites of the smaller intra-osseous tumours.

surface of the ramus of the right mandible. The skull itself was thickened, particularly over the vault, and the weight of the cap was definitely increased. In the ulnæ and femora, and to a lesser extent in the other bones, were numerous small foci of tumour growth. Many of these were not obvious to naked-eye inspection, being flush with the surface of the bone, but were readily located by reference to the X-ray photographs taken of these bones after their removal at autopsy (*Fig.* 219).

Histological Examination.—Sections of the main tumour mass in the lumbar spine showed it to be a spindle-cell carcinoma. Large areas showed advanced necrotic changes, with, in portions from the lower part, a superimposed mixed bacterial infection. The large tumours of the ulna and femur showed the same undifferentiated spindle-cell sarcoma structure (*Fig.* 220). In these there are no new bone spicules and only very little collagen fibril formation. The small tumours excavated from the lower end of the ulna and femur showed numerous osteoclastomatous giant cells in a vascular and cellular stroma (*Fig.* 221). The relative proportions of stroma and giant cells differed considerably in the different tumours examined, and while the stroma in some of them approximated to the sarcoma structure of the larger tumours, in a few the picture was distinctly reminiscent of that seen in benign osteoclastomata.

Sections of the thyroid gland showed areas in which there was some reduction in the colloid contents of the vesicles, with resultant apparent increase in the epithelial cellularity (*Fig.* 222), but nowhere did the appearances resemble that seen in *Case* 1, nor did the branches

of the thyroidal arteries in this case show the medial calcification which was such an outstanding feature of the first case. The parathyroid gland (*Fig.* 223) showed no abnormality beyond the same marked reduction in the number of oxyphil elements as was observed in *Case* 1.

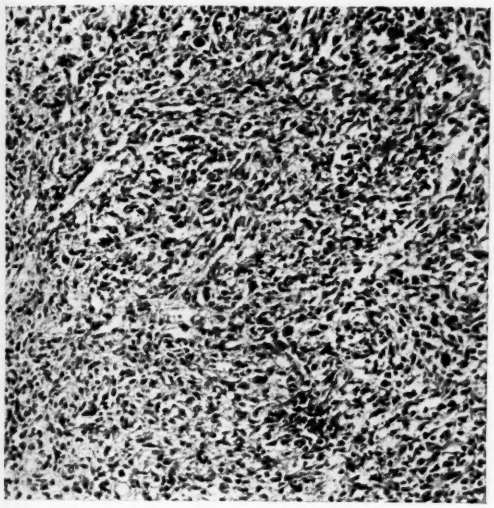


FIG. 220.—*Case* 2. Microscopical structure of main growth, showing typical spindle-cell sarcoma. (× 80.)

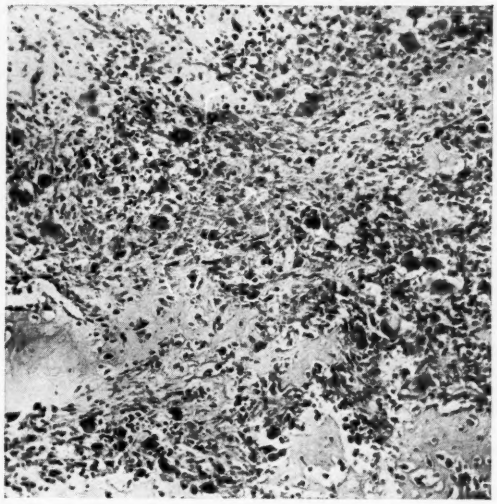


FIG. 221.—*Case* 2. Microscopical appearance of one of the smaller tumours from the ulna, showing œdematous loose-celled stroma containing numerous osteoclastomatous giant cells. (× 60.)

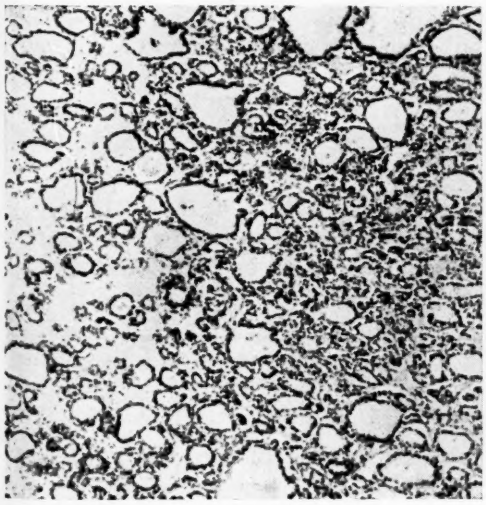


FIG. 222.—*Case* 2. Section of thyroid, showing poor colloid content of vesicles and an area of vesicle collapse. (× 60.)

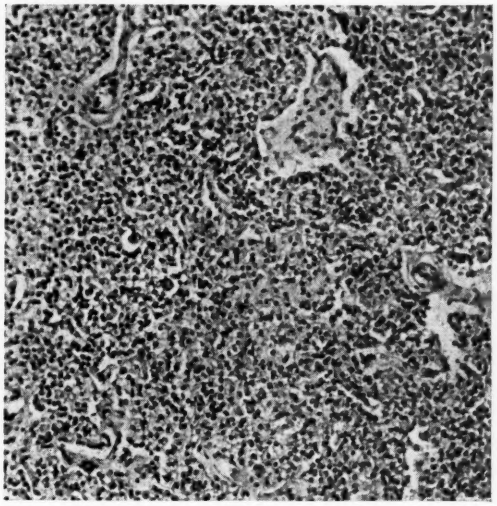


FIG. 223.—*Case* 2. Section of parathyroid, showing typical appearance of principal cells and absence of oxyphil cells. (× 85.)

Comment.—The main characteristics of sarcoma in Paget's disease are discussed later, and in the light of these it should be noted that the two cases described above present the following unusual features.

In both cases the development of multiple foci of primary sarcomatous change appears to be undoubted. In each case the appearance of one tumour mass in

association with bone is followed within a comparatively short time by the appearance of tumours in other bones, and in neither case did post-mortem examination show any intra-pulmonary or other visceral metastases which might suggest that the numerous bony tumours found at autopsy were the result of blood-borne dissemination.

The second uncommon feature is the apparently benign osteoclastomatous structure of some of the smaller tumours in both cases. It is to be noted that while the large frankly sarcomatous tumour masses in these cases partake of the nature of periosteal growths and are attached to, rather than growing in, the bones, these smaller benign-looking tumours are embedded in the bony corticalis. The resemblance of these small tumours to the more typical osteoclastomata which not infrequently complicate long-standing cases of generalized osteitis fibrosa with hyperparathyroidism is worthy of note, particularly in view of the generally accepted opinion that benign giant-cell tumours complicate only cases of osteitis fibrosa and never occur in osteitis deformans.

The third feature to which attention might be directed is the fact that in each case there appeared to be some abnormal feature of the thyroid and parathyroid glands in common. This point is of questionable value, and in our opinion may represent nothing beyond the chance association of lesions ; but in view of the general feeling that Paget's disease may be associated aetiologically with some endocrine disturbance, and that the parathyroid glands may influence growth in general, it seems right to us that particular attention should be drawn to these changes.

GENERAL DISCUSSION OF PAGET'S SARCOMA

Incidence Rate of Paget's Disease.—The frequency with which Paget's disease occurs in the general population is difficult to assess. American hospital records show an incidence varying from 1 in 10,000 to 1 in 16,000 (Bird, 1927). The incidence is probably considerably higher, as most uncomplicated cases are unlikely to attend hospital, and of those with complications it is probable that many are indexed only under the heading of the complication. There is also no doubt that many monostotic cases have been, and will continue to be, overlooked. These presumptions are borne out by the figures of the Peter Bent Brigham Hospital, where, amongst recent admissions of whom about 80 per cent were X-rayed, the incidence of Paget's disease was found to be about 1 in 3000 admissions (Bird, 1927).

In this country reports show the same wide range of incidence, while indicating in general a higher frequency than appears to be the case in America, and showing even more strikingly the greater apparent incidence when the patients under consideration have been subjected to special investigations likely to reveal skeletal abnormalities. O'Reilly and Race (1932) in a general review of the disease, supply the following figures :—

Hospital	Incidence
Leeds General Hospital, 1927–30	1 case per 3700 in-patients
London Hospital, 1926–29	1 case per 1400 admissions
Ditto 1930–31 (when bone dystrophies were under investigation)	1 case per 260 admissions
Guy's Hospital, Orthopædic Department	1 case per 130 cases treated
Devonshire Hospital for Rheumatic Diseases, Buxton	1 case per 170 cases treated

Relation of Paget's Disease to Coincident Sarcoma.—It will be obvious from the above that it is practically impossible to determine accurately the frequency of sarcoma arising in cases of Paget's disease from an examination of the published reports alone. Paget (1889) himself in his third paper expressed the conviction that there was an intimate connection between the disease and the formation of malignant tumours. He based his opinion on the follow-up of 8 of his original cases, amongst which he found 5 with malignant disease at the time of their deaths. Of these, two were definitely carcinomas, one was unspecified, one was an undoubted sarcoma, and one probably a sarcoma. Since that time attention has been directed to the association of Paget's disease with bone sarcoma rather than with malignant disease in general. On this subject there has been a considerable difference of opinion, and though to-day opinion on the whole is strongly in favour of the belief that Paget's disease does favour the development of bone sarcoma, there is still a considerable body of opinion which doubts this aetiological relationship. Packard, Steele, and Kirkbride (1901), and Higbee and Ellis (1911), in their general reviews of Paget's disease, concluded that the alleged propensity of these cases to the development of malignant disease was not proven, though the former authors admitted that " the high percentage of 7·5 per cent of sarcoma must have some significance ". Since 1912 numerous reviews and case reports have appeared upholding the close relationship between Paget's disease and sarcoma. Gruner, Scrimger, and Foster (1912) point out that " when a condition as relatively rare as Paget's disease comes to be associated with a second condition as uncommon as osteogenic sarcoma one cannot but seriously consider that this association is not one of mere chance or coincidence ". Bird (1927), reporting 6 cases of Paget's sarcoma and commenting on 3 others from the Registry of Bone Sarcoma, assumes this association, and finds that sarcomatous changes occurred in 11 per cent of the cases of osteitis deformans considered. He draws attention to the average age of his 9 cases, namely, 57 years, and, contrasting this with the average of 23 years in 39 cases of non-Paget's periosteal sarcoma (Gross, 1879), he concludes that " bone sarcomas occur in two large groups : (*a*) those of youth in which overgrowth arises in developing or healing bone ; and (*b*) those usually of later life in which the tumour originates from the irritated altered bone of osteitis deformans ".

In a more recent review Gerstel and Janker (1932) collected 39 cases of Paget's sarcoma (and 3 doubtful ones) from original papers, but were unable to obtain quite a number of reports which covered in their opinion a further 11 or 12 cases. Like Bird (1927) they find evidence in favour of the aetiological relationship of Paget's disease and sarcoma in the incidence frequency of the osteogenic sarcoma in the different age-groups, namely—4 in the 5th decade, 13 in the 6th, 19 in the 7th, and 3 in the 8th, which contrasts sharply with the incidence for non-Paget's bone sarcomas.

The most convincing arguments in favour of the predisposition of the bones in Paget's disease to the development of sarcoma are provided by Coley and Sharp (1931), who reviewed the literature and added three new cases. Their approach to the problem differs somewhat from those already considered. They investigated all cases of osteogenic sarcoma occurring in patients *over 50 years of age* (a total of 72 cases) which they were able to collect from the records of their hospital and from the American Registry of Bone Sarcoma. In no less than 20, i.e., 28 per cent, of these Paget's disease was present as well, and they were led to remark that " such

frequent association of two apparently dissimilar diseases justifies a careful study of the features presented in the different cases". This 'study' is most ably undertaken by them, and, among other points raised, they too stress the significance of the age incidence, and further, as shown in the accompanying table, draw attention to the remarkable simultaneous frequency-incidence of the two conditions.

OSTEOGENIC SARCOMA IN PATIENTS OVER 50 YEARS OF AGE

AGE	50–55	55–60	60–65	65–70	70–75	75+
Osteogenic sarcoma, all cases	19	19	13	13	7	1
Osteogenic sarcoma + Paget's disease	1	6	5	6	2	0
Percentage of cases of osteogenic sarcoma showing Paget's	5·3	31·6	39·2	46·2	28·6	0

In the age period 55 to 70 nearly 40 per cent of all osteogenic sarcomas occurred in patients with Paget's disease. When it is realized that in this series all declared cases of Paget's disease were confirmed by X rays and that in none of these cases did the sarcoma arise in bones not affected by Paget's disease, the evidence in favour of the conception of 'Paget's sarcoma' becomes almost irrefutable.

The literature on this subject is remarkably scanty in the French medical press, and Hagenau, Gally, and Daum (1934), reporting a case, could find reports of only 3 other French cases. From their survey of the general literature they conclude that "the possibility of sarcomatous transformation of Paget's disease appears incontestable", and adduce additional evidence in favour of this from the frequency of multiple coincident foci of sarcoma found in these cases. They point out that in Gerstel and Janker's series of 39 cases no less than 6 showed sarcomatous involvement of several bones more or less simultaneously. They quote Wanke (1932) as questioning whether this is not the result of multiple primary foci of origin rather than of metastases from a single primary, and point to the fact that osteogenic sarcoma not associated with Paget's disease does not behave in this way. Recently cases have appeared more frequently in the French journals, and Banzet, De Larue, and Elbim (1935), and Grizaud (1936), reporting single cases, concur with these opinions.

The general consensus of modern opinion appears thus to accept the fact that Paget's disease predisposes the affected bones to the development of osteogenic sarcoma. The frequency with which this malignant transformation occurs appears to vary considerably in different parts of the world, and Sear (1936), discussing this at the British Medical Association meeting in Australia, stated that while American authors compute the sarcoma incidence in Paget's disease as high as 14 per cent, and the figure in Germany is given as 5 per cent, in Australia, where the incidence of Paget's disease itself is high, the sarcoma incidence is so low (2 per cent) that he was inclined to doubt the alleged relationship between the two conditions.

Special Features of Paget's Sarcoma.—If we accept the aetiological relationship discussed above, then there are a number of its features which may profitably be considered in more detail.

Sex Incidence.—Paget's disease itself is commoner in men than in women. In America the proportion given by Bird (1927) is 65 per cent males to 35 per cent females, and in Germany Schmorl (1931), quoted by Gerstel and Janker, gives the proportion as 58 to 42. In the published reports of Paget's sarcoma an even greater preponderance of male cases is evident. This marked sex difference is probably the result of the combination of two contributory factors, namely, the preponderance in males of both Paget's disease and of osteogenic sarcoma *per se*. Coley and Sharp (1931), drawing attention to this superimposition of the two factors, point out that in 121 cases of osteogenic sarcoma at all ages and not associated with Paget's disease the proportion of males to females was 74 to 47 (i.e., 62 per cent to 38 per cent), while in their 20 cases of Paget's sarcoma 17 were males (85 per cent). Of the 49 cases of Paget's sarcoma we have been able to review, 45 (i.e., 92 per cent) were males.

Age Incidence.—The insidious nature of its development and its prolonged course make it extremely difficult to assign a definite date at which a case of Paget's disease can be said to have commenced. The age at which patients first present themselves for examination is usually recorded, but this is manifestly of little value, particularly in attempting to assess the duration of the disease prior to the supervention of sarcomatous changes. In the literature reviewed, the only figures which appear reliable are those of Packard, Steele, and Kirkbride (1901), who found that the average age of onset of Paget's disease in 51 cases was 49·5 years. In striking contrast with this is the exactness with which the date of commencement of malignant change can be obtained. The results of some of these observations are tabulated herewith.

AGE AT ONSET OF SARCOMA

AUTHOR	YEAR	NO. OF CASES	YOUNGEST	OLDEST	AVERAGE AGE
Bird	1927	9	36	69	57
Ochsner and Gage	1930	27	27	70	54
Coley and Sharp	1931	24	35	75	55–60
Gerstel and Janker	1933	39	36	78	59
Combined figures (Davie and Cooke)	1937	49	27	78	57·7

In this table the 39 cases collected by Gerstel and Janker include all 9 of Bird's, and most of those of the reviewed lists of Ochsner and Gage and of Coley and Sharp. The 49 cases of the 'combined figures' comprise the 39 of Gerstel and Janker, and in addition the two cases reported by us, the case described by Ochsner and Gage (1930), and seven other single cases collected from publications which have appeared since Gerstel and Janker's paper—those of Gougerot, Isay and Stehelin (1931), Perlman (1934), Hagenau, Gally, and Daum (1934), Banzet, De Larue, and Elbim (1935), Kienböck and Selka (1935), Parenti and Lüdeke (1935), and Grizaud (1936).

Duration of Paget's Disease before Sarcoma Develops.—Judging from the figures in the preceding section it would appear that the osteitis deformans is present on an average for about 8 years (49·5 years to 57·7) before sarcomatous changes supervene. This computation is in accord with published figures where this aspect has been specifically investigated. In 28 of the reported cases, including

the present two, we have found this point considered. The shortest period specified is 2 years and the longest 35 years, while the average works out at 12·1 years. In general it may be assumed that the alterations in the bony skeleton which predispose to sarcoma have to be present for a long time before malignant growth supervenes, recalling in this respect our conception of the part played by chronic irritation in the production of carcinoma rather than the usually accepted ideas of the possible association of trauma and sarcoma. The part which trauma, major or minor, may play in Paget's sarcoma is almost impossible to assess, and an examination of the literature throws no real light on the problem, though Grizaud regards it as sufficiently important to warn patients with Paget's disease against the dangers of trauma on these grounds.

Site of Sarcoma Development.—An outstanding feature, observed by most of the authors consulted, is that sarcomatous changes have not been observed in any of their cases except in those bones which show coincident and characteristic changes of osteitis deformans. In many of the papers a further point is stressed, namely, that the sarcoma usually arises in those bones which clinically, or by other investigations, appear to have been longest and most severely affected by Paget's disease. An analysis of the available records show that in 34 cases of monostotic sarcoma the order of frequency of affection of the different bones is as follows: humerus 11, femur 10, skull 4, tibia 3, scapula 2, radius 1, clavicle 1, pelvis 1, vertebral column 1. In the 15 cases of multiple foci of sarcoma the bones first affected are again most frequently the humerus, femur, and skull, but thereafter the pelvis and vertebræ appear more frequently as primary sites than the other bones listed in the monostotic cases.

Multicentric Foci of Sarcoma.—This unusual feature of the sarcoma that it occurs in several bones more or less simultaneously, is very much more common in these cases than in osteogenic sarcoma uncomplicated by Paget's disease. It is reported as the main feature in no less than 15 out of the 49 cases studied. This is almost certainly a false expression of its frequency for reasons previously given, but it is nevertheless sufficiently frequent and characteristic to justify the conclusion that Paget's sarcoma is in this respect different from osteogenic sarcoma in general. The condition is independent of the phenomenon of metastasis, and is often present in the absence of blood-borne secondary deposits in the usual sites. The multiple foci all appear in bones previously affected by Paget's disease, and, in our two cases at least, the frankly sarcomatous tumours are associated with a more generalized evidence of neoplastic alterations, resulting in the evolution of tumour foci showing all grades of malignancy from the typical sarcomas down to tumours resembling benign osteoclastomas. The significance of this feature, and particularly its value as evidence of the aetiological relationship between Paget's disease and the coincident sarcoma, is realized when it is remembered that while ordinary osteogenic sarcoma is apt to metastasize early, and particularly into the lungs, it very rarely produces metastases in bone.

Microscopical Features.—The structure of Paget's sarcoma shows the same variation in histological type found in osteogenic sarcoma generally. In the majority of reported cases the microscopical type is referred to as osteogenic, spindle-cell, or mixed-cell sarcoma. In a few some differentiation to fibrosarcoma or to true osteosarcoma is apparent, and in one case the structure is reported as osteo-chondro-sarcoma (Wanke, 1932). In four cases the type is reported as predominantly

round-cell sarcoma (*see* Gerstel and Janker's tables). In three cases there is specific mention of an admixture of giant cells (Packard, Steele, and Kirkbride, Gerstel and Janker's own case, and that of Pick and Martin's personally communicated to them), but these are typically malignant giant cells. In only two reports is there any mention of giant cells of the foreign body or osteoclastoma type, namely, in Bird's *Cases* 1 and 9, and it is of interest to note that in the latter case the growth had actually been diagnosed at an earlier examination of some biopsy material as " benign giant-celled tumour ". The coexistence of fully developed sarcoma and of benign giant-cell tumours is nowhere reported, and even Bird is of the opinion that the presence of the giant cells in his two cases was in the nature of a reaction to the sarcoma. While this is certainly a rational explanation, we are doubtful whether this explanation can account for the frequency of these cells in the small tumours in our cases. We are of opinion that they represent an early expression of the neoplastic evolution in the hyperplastic inter-trabecular connective tissue of Paget's disease. That sarcoma may develop from an osteoclastoma is well recognized, as is the fact that in these malignant transformations there is often complete absence of the multinucleated osteoclastic giant cells. There is thus no basic reason for denying the possible coexistence of these tumours, nor does there appear to be any fundamental reason why benign osteoclastomata should not appear in cases of Paget's disease which are complicated by sarcomatous transformation.

Coincident Changes in other Organs.—In most of the reports some reference is made to a search for pathological changes in organs and tissues other than the skeletal system. The endocrine organs and the arterial system are those most frequently examined and in which abnormalities have occasionally been reported. As would be expected from the many points of similarity between osteitis deformans and osteitis fibrosa, the parathyroid glands are, nowadays at least, most frequently examined. The pronouncement here seems clear and unequivocal, namely, that there is no macroscopic evidence of neoplastic or hyperplastic changes in these glands. Of any microscopical deviations from the normal little can be gleaned from the literature. In our two cases there appeared to be evidence of reduction in the oxyphil-cell content of the glands. This may have some significance in view of the fact that at the age period at which Paget's disease, and, even more, Paget's sarcoma, is commonest, the oxyphil-cell content of these glands is normally high (T. L. Hughes—private communication, unpublished thesis), and since also, in the view of some endocrinologists, these cells may be concerned with the elaboration of a growth-retarding hormone. The study of this hormone is still in its experimental stages (Eastland, Evers, and Thompson, 1932, and Thompson and Huxley, 1934), but should its relationship with the oxyphil cells be established, the bearing of this point on the supervention of malignant changes in Paget's disease will obviously call for closer examination in the future.

Changes in other endocrine glands have also received some attention. The pituitary gland has usually been reported as normal, or at most as somewhat atrophic in appearance (Gruner *et al.*, 1912). The thyroid gland, on the other hand, has on several occasions been reported as exhibiting abnormal features. Higbee and Ellis (1911) give a detailed account of the thyroid in their case. The gland was small, pale, and flabby, and microscopically the interstitial tissue was increased and the parenchyma reduced to small irregular masses of epithelial cells. The most striking feature was the scanty colloid content and the shrunken condition of the

acini, which were however not empty, as the spaces were partly or wholly filled with proliferated or desquamated epithelial cells. The resultant picture was one closely resembling the histology of the parathyroid gland. They state that there was doubtless some lessening of the thyroidal function, but are doubtful whether this had any aetiological significance. Their own study of the literature at that time revealed only two other cases in which there was evidence of a similar type of hypothyroidism, and one other case in which it had been suggested that the enlarged thyroid present might possibly have had some aetiological significance.

The thyroid changes cited above were all found in cases of uncomplicated Paget's disease. In our review of the literature of Paget's sarcoma, only two specific references to thyroid abnormalities have been found. The case of Gruner, Scrimger, and Foster (1912) showed a marked increase of the fibrous-tissue stroma of the thyroid gland with separation of the gland acini, while Packard, Steele, and Kirkbride (1901) regarded the thyroid in their case as macroscopically abnormal but express regret that it was unfortunately not preserved for histological examination. There appears thus to be little reason for incriminating the thyroid as the site of those metabolic changes which it is presumed by most are the basis of the bony changes which characterize Paget's disease. The remarkable similarity between the thyroid in our first case and in that of Higbee and Ellis does however justify special mention, if only that by so doing others may be stimulated to make a detailed histological examination of the thyroid gland in all cases of Paget's disease, an examination which it is evident has very frequently been neglected in the past.

Of the other endocrine glands only the adrenals receive occasional mention, and then only to record that they have shown no abnormality.

The arterial tree is the only other system in which pathological lesions are recorded with considerable frequency. The change noted is almost invariably some degree of arteriosclerosis, but as Paget's disease and arteriosclerosis occur with greatest frequency in the same age period, most observers record the arterial changes without any implications as to their aetiological significance.

It is however possible that the arteriosclerosis, such as was noted in the thyroid arteries in our first case, may be the cause of some of the changes noted in the thyroid gland, and that similar vascular changes may account for the occasional evidences of pituitary atrophy. The converse relationship, it must be remembered, may actually be active, inasmuch as the arterial changes may themselves be an expression of an endocrine imbalance or dyscrasia, and to this extent be but the arterial manifestation of an endocrine disturbance which in the bony skeleton is manifesting itself as Paget's disease.

Biochemical Investigations.—In cases of Paget's disease, biochemical investigations, particularly of the blood, reveal that while there are no significant alterations in the serum concentration of calcium and phosphorus, there appears to be no doubt that the phosphatase figure is usually raised considerably above the normal. Gutman, Tyson, and Gutman (1936) showed that in every one of their 75 cases the phosphatase figure was above the normal of 4 Bodansky units, and in the 51 advanced and widespread cases the average figure was 55 units, or nearly 14 times normal (variation range from 2·5 times to 32 times normal). This raised phosphatase value is, however, not peculiar to Paget's disease, and though therefore of little diagnostic value, it is possible that it may prove to be valuable as an index of the efficiency or otherwise of therapeutic measures adopted.

Aetiology.—We have already attempted to justify the more or less general view that the supervention of sarcoma in cases of Paget's disease is intimately associated with the nature of the bony changes in this disease and not merely the result of chance coincidence. Our views as to the factors which determine the development of an osteogenic sarcoma in bones affected by the changes of osteitis deformans are necessarily limited by our ignorance of the cause of malignant growths in general and of the cause of Paget's disease itself. In the light of the relationship of these two conditions it is probable that a true appreciation of the aetiology of Paget's disease may throw some light on the essential nature of malignant neoplasms in general, at any rate as far as those tissue alterations are concerned which might be regarded as pre-cancerous.

With regard to osteitis deformans itself, Paget believed that the disease was of the nature of a chronic inflammation of the bones. Since his time various theories have been put forward, but none has been proved. It appears to be established that there is no definite hereditary or congenital factor. The chronic specific infections also appear to play no part, in spite of the alleged amelioration of symptoms which, it is claimed by the French, follow anti-luetic treatment. Lievre (1936) claims that trauma may be the cause of monostotic cases, while O'Reilly and Race consider it is primarily a local affection of the reticular cells of the bone closely akin to the reticulo-endothelioses. The part played by arteriosclerosis has already been discussed. The demineralization of the affected bones and the final histological picture bear so strong a resemblance to the more widespread changes in generalized osteitis fibrosa of von Recklinghausen that some overlap in aetiology was inevitably sought. The adenomatous hyperplasia of the principal cells of the parathyroids, which has been proved to be the main factor in the production of osteitis fibrosa, is certainly not operative in osteitis deformans, and, in fact, in spite of the evident desire on the part of many to ascribe Paget's disease to some form of endocrine imbalance there is really very little evidence that any of these glands are at fault. The possible parts played by the oxyphil cells of the parathyroid and by the thyroid, possibly in conjunction with each other, have been mentioned in this article; but as yet even the changes described have not been noted in more than a small proportion of cases, and much further investigation is required on this aspect of the disease.

Moehlig and Murphy (1935) regard the disease as a constitutional abnormality, and maintain that it occurs in families in which a higher proportion than normal of the members show excessive tallness, obesity, and diabetes mellitus. In the production of this constitution type they believe the pituitary is primarily at fault and the parathyroids secondarily involved, and they go so far as to suggest that on eugenic lines the intermarriage of persons showing this tallness-obesity-diabetes tendency should be prohibited on account of the probability of osteitis deformans appearing in the offspring of such unions.

The disease has never been produced experimentally. Moehlig, Murphy, and Reynolds (1935) tried to produce it in dogs by injections of extracts of anterior pituitary and parathyroids. The only change produced in the bones of these animals consisted of a replacement by calcific deposits of much of the marrow; the typical alterations seen in osteitis deformans never appeared. Other changes, particularly in the blood biochemical values, were however regarded as important, in particular the rise in blood-calcium and the marked fall in blood-phosphatase

which resulted under the influence of these hormonal injections provided that glucose was added to the diet of the animals. As a result of these observations and of the knowledge that high phosphatase value followed depancreatization in dogs, they were led to treat their cases of Paget's disease by controlled dietary and insulin injections. The result was almost immediate relief of the 'bone pains', and a fall in the blood-phosphatase. These striking results await confirmation, and appear to merit further and extensive investigation.

Regarding the stimulus which determines the development of a sarcomatous neoplasm in the hyperplastic inter-trabecular connective tissue in the bones, we are as ignorant as we are of the conditions which lead to Paget's disease itself. It appears unlikely that this is associated with isolated chance trauma for several reasons. In the first place histological and anatomical examination appears to have established the fact that these sarcomata usually develop at sites which not only show the most advanced changes of Paget's disease but which are also the points of greatest stress within the bones, and not at those points which are most frequently exposed to trauma. In the second place the frequent occurrence of multicentric foci of sarcomatous change is more suggestive of a generalized stimulus than of a local one such as would be operative if accidental trauma were the cause. In the third place an examination of the literature reveals very few cases in which a history of such trauma is cited by the patients concerned, and this in spite of a well-recognized proclivity of patients in general towards such claims.

If trauma is thus eliminated as the stimulus to malignant supervention, the other possibilities for consideration are: (1) the stimulus of inflammatory reaction; and (2) some generalized hormonal, endocrine, or metabolic influence acting either directly as an excitant or indirectly by producing a disturbance in those factors which normally determine the limitation of growth.

With regard to the first suggestion, it must be pointed out that Paget's disease is no longer regarded as an inflammatory change itself, nor has it ever been suggested that infection of the vascularized connective tissue in the bones is necessary for the development of sarcomatous changes. The question of a possible carcinogenic function of some virus infection has, as far as we can ascertain, not as yet been considered in relation to Paget's sarcoma.

The other suggestion is obviously, in the light of our present knowledge, at best a basis for theorizing on the causation of cancer in general. The definitely sarcomatous predisposition inherent in Paget's tissue does, however, appear to lend itself to experimental investigation, and it is unfortunate that such research is at present precluded by our inability to produce the disease in animals.

Prognosis.—The outlook in Paget's sarcoma is extremely bad. The average duration of life after detection of the malignant changes in Bird's (1927) 9 cases was about eight months; Ochsner and Gage (1930) report that of the 31 cases they reviewed all but one were dead within a few months; while Coley and Sharp (1931) report a 100 per cent mortality in spite of varied therapeutic measures. These latter authors suggest that a possible cause for this may be found in the advanced condition of the sarcomas usually present by the time the patients present themselves for medical examination, a state of affairs which probably results from the fact that as these patients have for long been accustomed to severe pains in their bones, the supervention of malignancy is not in them accompanied by an alteration in their symptoms such as would ordinarily occasion a visit to a doctor.

Coley and Sharp also suggest the possibility that Paget's sarcoma might be less painful and inherently more rapid-growing than other osteogenic sarcomas. The second part of this suggestion appears rational, inasmuch as the sarcoma, once initiated, grows and spreads in tissue which is already apparently pre-sarcomatous. The multiple growths found in so many of the cases must also contribute in some measure to the rapid progress to a fatal issue.

Treatment.—Until the cause of Paget's disease itself is known the treatment of Paget's sarcoma can differ in no way from that of rapidly growing osteogenic sarcoma in general. In the reported accounts of these cases there are recorded all the usual lines of treatment—local extirpation, amputation, Coley's fluid, and radiation therapy—with little in the results to indicate a future preference for any one of these therapeutic measures. Coley and Sharp (1931) suggest that the abnormal character of this sarcoma calls for special treatment, and they recommend a combination of pre-operative deep X-ray or radium pack radiation, amputation, and a post-operative course of injections of Coley's fluid. They record that one case so treated was still free from recurrence nine months later. Apart from this the only other therapeutic observation of note is that of Hagenau, Gally, and Daum (1934), who found that intensive radiation, while having no effect on the rate of growth of the tumour, was eminently effective symptomatically in that it rendered the terminal stage of the disease completely free from pain. This they regard as a noteworthy observation, as ordinarily the pain in the terminal stages of osteogenic sarcoma is severe, and may be agonizing in its intensity.

SUMMARY

Two cases are described of multicentric foci of osteogenic sarcoma arising in patients suffering from Paget's disease (osteitis deformans). The features of this 'Paget's sarcoma' are discussed in the light of information obtainable from a review of the literature. The features particularly studied are: the aetiological relationship of sarcoma to the coincident Paget's disease; the sex and age incidence; the time factor in the development of the sarcoma; the sites of election of the sarcoma; the multicentricity of foci in these growths; the microscopical features; coincident changes in other organs and tissues; views as to the aetiology of Paget's disease; the nature of the initiating stimulus resulting in sarcomatous change; prognosis and treatment.

The conclusions drawn from these considerations are that Paget's disease predisposes affected bones to sarcomatous changes, and that this malignant supervention arises at sites of stress in those bones showing advanced changes of osteitis deformans, possibly as the result of the stimulus of a superadded endocrine disturbance.

It gives us great pleasure to acknowledge our indebtedness to Dr. P. H. Whitaker and Dr. E. L. Rubin, of the Radiology Department of the Liverpool Royal Infirmary, for their assistance in connection with the radiographs from both cases, and to Professor Henry Cohen and Dr. T. Hewer, both of the University of Liverpool, for their clinical and post-mortem records in connection with the second case.

REFERENCES

BANZET, P., DE LARUE, J., and ELBIM, A., *Presse méd.*, 1935, xliii, 1842.
BIRD, C. E., *Arch. of Surg.*, 1927, xiv, 1187.
COLEY, B. L., and SHARP., G. S., *Ibid.*, 1931, xxiii, 918.
EASTLAND, C. J., EVERS, N., and THOMPSON, J. H., *Biochem. Journal*, 1932, xxvi, 2123.
GERSTEL, G., and JANKER, R., *Deut. Zeits. f. Chir.*, 1933, ccxxxviii, 577.
GOUGEROT, ISAY, and STEHELIN, *Bull. Soc. franç. Dermatol. et Syph.*, 1931, xxxviii, 1278 (abstr. in *Amer. Jour. Cancer*).
GRIZAUD, H., *Presse méd.*, 1936, xliv, 1018.
GROSS, S. W. (quoted by BIRD), *Amer. Jour. Med. Sci.*, 1879, lxxviii, 2.
GRUNER, O. C., SCRIMGER, F. A. C., and FOSTER, L. S., *Arch. of Internal Med.*, 1912, ix, 641.
GUTMAN, A. B., TYSON, T. L., and GUTMAN, E. B., *Ibid.*, 1936, lvii, 379.
HAGENAU, J., GALLY, L., and DAUM, P., *Bull. et Mém. Soc. méd. Hôp. de Paris*, 1934, l, 786.
HIGBEE, W. S., and ELLIS, A. G., *Jour. Med. Research*, 1911, xxiv, 43.
KIENBÖCK, R., and SELKA, A., *Beitr. z. klin. Chir.*, 1935, clxii, 246.
LIEVRE, J. A., *Presse méd.*, 1936, xliv, 45.
MOEHLIG, R. C., and MURPHY, J. M., *Endocrinology*, 1935, xix, 515.
MOEHLIG, R. C., MURPHY, J. M., and REYNOLDS, L., *Amer. Jour. Rœntgenol.*, 1935, xxxiv, 465.
OCHSNER, A., and GAGE, J. M., *Surg. Clin. N. Amer.*, 1930, Aug., 851.
O'REILLY, T. J., and RACE, J., *Quart. Jour. Med.*, 1932, i, 471.
PACKARD, F. A., STEELE, J. D., and KIRKBRIDE, T. S., *Amer. Jour. Med. Sci.*, 1901, cxxii, 552.
PAGET, J., *Illus. Med. News*, 1889, ii, 181.
PARENTI, G. C., and LÜDEKE, H., *Virchows Arch.*, 1935, ccxcvi, 200.
PERLMAN, R., *Jour. Bone and Joint Surg.*, 1934, xvi, 594.
SCHMORL, G., (quoted by GERSTEL and JANKER), *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1931, xliii, 202.
SEAR, H. R., *Brit. Med. Jour.*, 1936, i, 49.
THOMPSON, J. H., and HUXLEY, J. S., *Jour. of Exper. Biol.*, 1934, xi, 273.
WANKE, R., *Deut. Zeits. f. Chir.*, 1932, ccxxxvii, 198 (abstr. in *Amer. Jour. Cancer*).

PRIMARY PLEURAL CYSTS*

By A. L. D'ABREU

SENIOR ASSISTANT IN THE SURGICAL UNIT, WELSH NATIONAL SCHOOL OF MEDICINE, ROYAL INFIRMARY, CARDIFF
ASSISTANT THORACIC SURGEON, WELSH NATIONAL MEMORIAL ASSOCIATION

THE object of this paper is to demonstrate the existence and clinical significance of primary cysts of the pleura and to differentiate them from dermoid, hydatid, bronchogenous, and œsophageal cysts. Encysted pleurisy usually has a tuberculous or pyogenic origin and should not be confused with the condition described here.

CASE REPORTS

L. S., aged 33, a miner, complained of shortness of breath on exertion and of pain in the lower part of the right side of the chest for nine months; he had not worked for seven months when he consulted Dr. Melville Hiley, of the Welsh National Memorial Association. He declared that he had injured the chest seven years previously. Dr. Hiley found dullness at the right base, but no clinical evidence of tuberculosis; the radiographs showed a remarkable picture (*Figs.* 224, 225). On the antero-posterior view there was a large circular shadow

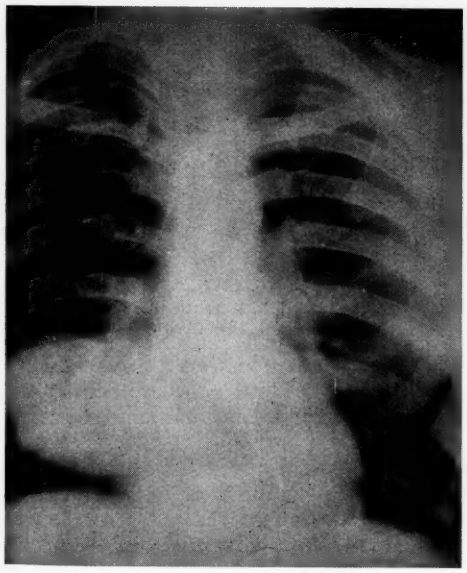


FIG. 224.—An antero-posterior radiograph showing opacity in the right side of the chest.

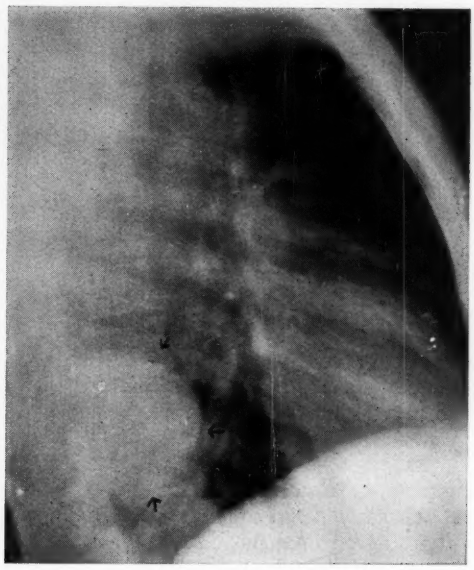


FIG. 225.—Lateral radiograph. The opacity is indicated by arrows.

continuous apparently with the cardiac shadow, but shown by the lateral view to be in the costovertebral groove in the posterior mediastinum.

* Based on a communication to the Association of Thoracic Surgeons of Great Britain and Ireland at the Annual Meeting at Manchester, November 26 and 27, 1936.

The diagnosis of hydatid cyst or of posterior mediastinal tumour (fibroma or neurofibroma) was considered probable. There was no eosinophilia, but the Casoni reaction was not done. A radiograph taken after a diagnostic artificial pneumothorax had collapsed the lung established the extra-pulmonary site of the tumour.

OPERATION (Sept. 4, 1936).—Under intratracheal gas and oxygen the right pleural cavity was opened by a long intercostal incision through the 7th interspace. One inch of the 7th rib was removed just anterior to the angle, and the pleural cavity was widely opened by a modified Tuffier's retractor. There were no adhesions and the lung collapsed; a large bluish cyst 4 in. long and about 2 in. wide was seen overlying the 7th, 8th, and 9th ribs in the costovertebral angle. It had none of the appearances of a hydatid cyst, being covered by shiny healthy pleura; formalin, however, was injected into the cyst as a precaution. The swelling was then removed, the supplying vessels, which were of considerable size and running in the wall of the cyst, being secured with cholecystectomy forceps and tied (*Fig.* 226). There were no adhesions to the lung and the cyst lay in a bed

FIG. 226.—The excised cyst. Note the large blood-vessels in the wall.

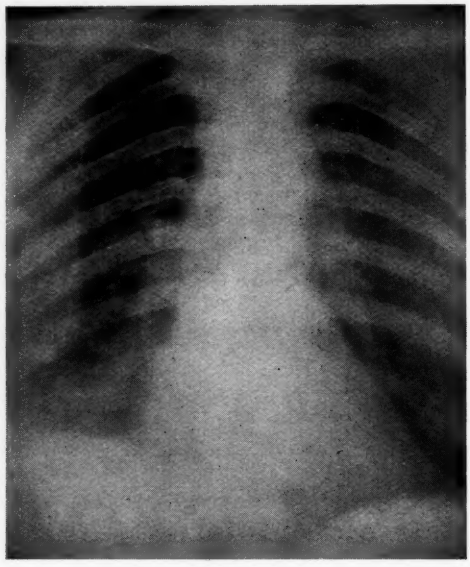


FIG. 227.—A radiograph taken thirteen days after operation, showing a little fluid above the diaphragm.

composed of endothoracic fascia, ribs, and muscle. The chest was then closed with five pericostal sutures and by suturing the overlying muscles in two layers by continuous catgut. The pleural cavity was drained through an intercostal stab wound, from which a tube led to a water-sealed drainage bottle.

PROGRESS.—Recovery was uneventful. A radiograph taken the next day showed almost complete expansion of the lung. As nothing drained from the tube after forty-eight hours (10 ounces of blood-stained fluid came away in that time) it was removed. A second radiograph showed an almost fully expanded lung. The wound healed by first intention; the patient was allowed up on the tenth day and went home three days later. A radiograph on the day of discharge showed a little fluid above the diaphragm (*Fig.* 227). This fluid has since disappeared and the patient is well and symptom free.

Commentary.—The diagnosis of this condition before operation was uncertain, an innocent tumour of the posterior mediastinum having been anticipated. Thoracotomy was necessary to relieve the symptoms and to remove a space-occupying tumour of the thorax.

PATHOLOGY.—The cyst contained about eight ounces of fluid; examination showed this to be essentially serous in nature, with no cholesterol crystals or blood-pigment derivatives. The histological examination of the wall showed it to be composed of fibrous tissue lined by

flattened endothelial cells; there was no evidence of an inflammatory process and this discountenances a diagnosis of encysted pleurisy.

The origin of such a cyst is doubtful but is considered to be congenital. Diverticula of the pleuro-peritoneal cavities are well known to embryologists. To faulty closure of these diverticula may be ascribed the rare sub-serous cyst encountered in the peritoneal cavity and now described in the pleura.

A similar cyst was removed by the late Mr. H. P. Nelson, and is reported here with the permission and help of Mr. J. E. H. Roberts.

E. T., a labourer, aged 53, had been said to suffer from an aneurysm in the arch of the aorta for five years. When seen in August, 1933, he complained of pain in the right side associated with weakness and cough. The temperature was 100°, the pulse 100, and the respirations 28. The cardiac dullness was obscured by emphysema, and râles were present at both bases, but without alteration in the percussion note or breath-sounds. The pupils were small, but reacted to light; the knee-jerks were absent and anæsthesia of a tabetic distribution was present.

X-RAY EXAMINATION.—A circular opacity the size of a golf ball, with sharp margins but of only moderate density, was present in the right cardiophrenic angle; a lateral view showed this opacity to be spherical and placed anteriorly in the angle between the diaphragm and the thoracic wall. Otherwise the mediastinum and lung fields were normal.

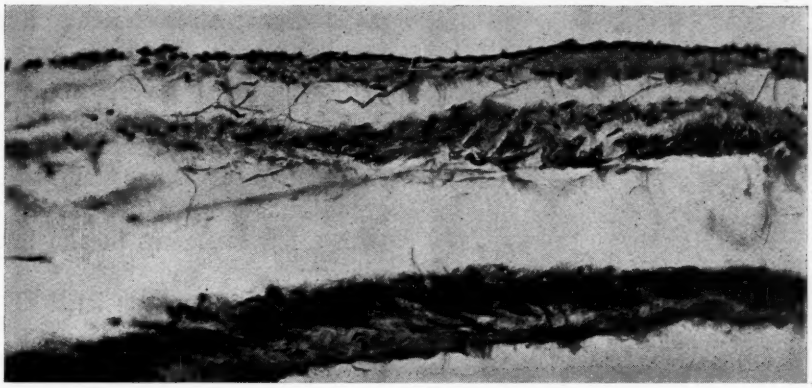


FIG. 228.—Microscopical appearance of cyst wall, showing fibrous tissue lined by flattened endothelial cells.

OPERATION.—This was advised and carried out by Mr. H. P. Nelson. Under intra-tracheal gas and oxygen and ether the 6th space was opened by a long intercostal incision; there were no adhesions and the lung collapsed. The space was opened widely by the rib spreader, and a cyst, which was not tense, with clear transparent walls and 2 in. in diameter, was seen. The swelling was attached over an area 1 in. in diameter to the back of the costal cartilages at their junction with the sternum, about half an inch above the origin of the diaphragm, and was covered by pleura; this was divided around the base and the cyst dissected away; the wound was completely closed.

POST-OPERATIVE PROGRESS.—The temperature rose to 103° F., but shortly subsided; the general condition remained good in spite of some cough and sputum. The stitches were removed on the ninth day, but the wound gaped: this was thought to be due to a collection of fluid at the base, and accordingly 10 oz. of blood-stained fluid was aspirated. The condition rapidly improved and on discharge two months later the wound was soundly healed. A radiograph showed the right cardiophrenic angle to be clear, and apart from some dilatation of the aorta nothing abnormal was detected. He has since been seen by Mr. Roberts two years after the operation: the pain that was present before operation has been relieved, though he still suffers from occasional twinges in the right costal margin. The scar is sound, and the lungs normal apart from some emphysema and bronchitis on both sides. *Fig.* 228 is a photograph of the lining of the cyst wall, which has the characteristics noted in the other simple sub-pleural serous cyst.

DISCUSSION

Pickhardt[1] describes a pleuro-diaphragmatic cyst removed from a woman, aged 53, at the Lennox Hill Hospital in New York in 1931. For some weeks she had complained of a sharp knife-like pain over the pericardium and a less acute pain in the left lower antero-lateral region of the chest. Two years previously she had been told that she was suffering from a left-sided pleurisy, the symptoms being of the same nature as those in the recent illness. A radiograph showed circular shadows just above the left side of the diaphragm. Thoracoscopy combined with a diagnostic artificial pneumothorax revealed a yellowish, smooth, glistening tumour in the left pleural cavity, the size of a tangerine. The appearance suggested a diagnosis of lipoma, but at a subsequent thoracotomy through an intercostal incision a thin-walled cyst lying in the costophrenic angle at the junction of the diaphragm apex of the pericardium and thoracic cage was removed. The cyst was covered by diaphragmatic parietal pleura and by fat pads from the pericardium; after dissection a raw area was left on the diaphragm, and this was covered by stitching the pleura over it. The chest was closed without drainage. The patient made a rapid recovery with complete relief of the pain. A radiograph later showed normal lung fields, with a few adhesions in the left costophrenic angle.

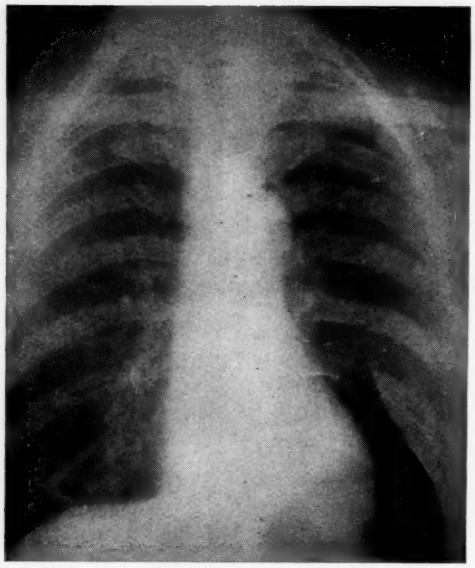


FIG. 229.—Radiograph showing pedunculated swelling in left chest in a suspected case of simple serous cyst.

The specimen consisted of a large thin-walled cyst about 8–9 cm. in diameter, roughly globular in shape, with a smaller attached secondary mass about 1·5 cm. in diameter; there appeared to be no direct connection between the two cavities. The microscopical appearance showed a thin wall of dense laminated tissue which was largely acellular; the inner surface was covered with small, deeply staining cells of endothelial type.

Parkes Weber and Schwarz[2] described in 1934 a cyst of the thorax that lay outside the parietal pleura. In a man of 63 suffering from advanced carcinoma of the liver, a radiograph showed two closely adjacent spherical bodies, likened to billiard balls, situated above the diaphragm in the left outer part of the thoracic cavity. The patient died, and the autopsy revealed a bilocular cyst, containing serum, situated in the loose connective tissue about the extreme left part of the diaphragm; it was covered by pleura, and, although indenting the lung, was not adherent to it. A microscopical examination of the wall showed that it was fibrous with an endothelial lining and with some lymph-follicles present in the wall reminiscent of the so-called branchial cysts. A congenital origin of the swelling was suggested.

Professor Lyle Cummins has shown me a radiograph of a patient who I believe has a simple serous cyst of the pleura (*Fig.* 229). In the left side of the chest is a pedunculated swelling with a well-defined pedicle. On the screen, although this swelling moves it is not attached to the lungs; the patient is symptom free.

In 1926, Tudor Edwards[3] described in the BRITISH JOURNAL OF SURGERY the successful removal of a large cyst from the pleural cavity of a woman of 30. Briefly, she had suffered from pain in the left side of the chest associated with cough for seven years, the last three being spent in a sanatorium; though there had been considerable loss of energy and strength and a good deal of dyspnœa there had been no loss of weight; no tubercle bacilli were detected in the sputum; the radiograph showed a large pear-shaped shadow with its apex towards the middle of the heart shadow. On two occasions large amounts of straw-coloured fluid were aspirated; further exploration showed that the fluid became brownish and contained cholesterol crystals. Under intratracheal anæsthesia, the left side of the chest was opened through the fifth space and a large tumour was exposed; this was adherent to the lung, diaphragm, and pericardium; to the last structure there was dense adhesion over an area the size of a five-shilling piece. The whole cyst was removed except for a little piece attached to the pericardium. The cyst, which contained 1½ to 2 pints of fluid, is now in the Museum of the Royal College of Surgeons of England. It measured 5 in. in diameter, was partly covered by loose areolar tissue, and had a smooth lining with no epithelial or endothelial structure. The patient made an excellent recovery, the lung fully expanding, and all physical and radiological signs disappeared. Although for three years before operation the condition had been considered to be a localized tuberculous effusion, the lack of generalized symptoms, the nature of the fluid, and the radiological and operative findings were all opposed to this diagnosis. In the absence of true cellular lining, the exact diagnosis and origin of the cyst remained obscure; was it a dermoid cyst that arose in the anterior mediastinum to become displaced along the line of least resistance, or was it a primary diverticulum from the pericardium?

Dickson Wright[4] has recently published a paper which suggests that cysts may develop from the pericardium. A young man of 25 received a chest injury which was followed by pain for six years. The persistence of this symptom led to radiological examination, which disclosed a circular calcified shadow which moved with the heart beats. A diagnostic artificial pneumothorax showed that the tumour was not attached to the lung. By an incision through the 5th intercostal space the tumour was removed; it was adherent to the pericardium but the cavity was not opened, and the tumour therefore presumably lay between the two layers of the pericardium. So calcified was the mass that it required a hack-saw to open it; it contained cholesterol crystals and iron, but no hooklets or hair or keratin. The wall was composed of laminated fibrous tissue. Its pericardial origin is suggested by its dense calcification, for lesions of that structure have a strong tendency to such impregnation.

SUMMARY AND CONCLUSIONS

Though apparently rare, the occurrence of simple serous cysts of the pleura appears to be proved. In none of the cases discussed here do the conditions found at operation suggest tuberculous disease or dermoid, hydatid, bronchogenous, or

œsophageal cysts, while the absence of any inflammatory signs in the histological pictures excludes a diagnosis of encysted pleural effusion. Although the examples recorded by Dickson Wright and Tudor Edwards suggest a pericardial origin, no such possibility is postulated for those described in this paper, which are subserous cysts lying within the thorax but external to the parietal pleura. The classification of simple serous intrathoracic cysts as pericardial or pleural in origin is suggested. The occurrence of the latter group in the lower part of the thorax near the diaphragm makes the possibility of their development from faulty processes in the closure of the pleuroperitoneal membranes quite feasible.

It is important to remember the condition of simple pleural cyst when confronted by an intrathoracic tumour that is shown by investigations, including artificial pneumothorax, to be extra-pulmonary, for the prognosis is excellent and its eradication is a safe procedure. The presence of pleuritic pain, the absence of physical signs in the early stages, and the inestimable value of radiology are noteworthy.

I am extremely grateful to Mr. J. E. H. Roberts for his help and encouragement, and for his permission to include the notes of the case operated upon by the late Mr. H. P. Nelson.

REFERENCES

[1] PICKHARDT, O. C., *Ann. of Surg.*, 1934, xcix, 814.
[2] WEBER, E. PARKES, and SCHWARZ, E., *Brit. Med. Jour.*, 1934, i, 851.
[3] EDWARDS, TUDOR, *Brit. Jour. Surg.*, 1926–27, xiv, 607.
[4] WRIGHT, A. DICKSON, *Ibid.*, 1935–36, xxiii, 612.

TWO CASES OF DIAPHYSIAL ACLASIS SHOWING SARCOMATOUS CHANGE

By E. K. GARDNER, London

Sir Arthur Keith[9] has given the name of diaphysial aclasis to an hereditary condition exhibiting multiple exostoses, because he considered the disease to result from a retardation of the process of modelling, the consequence of an arrest of periosteal extension at the ends of the diaphysis. There results an irregularity of the metaphysis, associated with an excessive formation of cancellous bone and a diminished encasement of cortex.

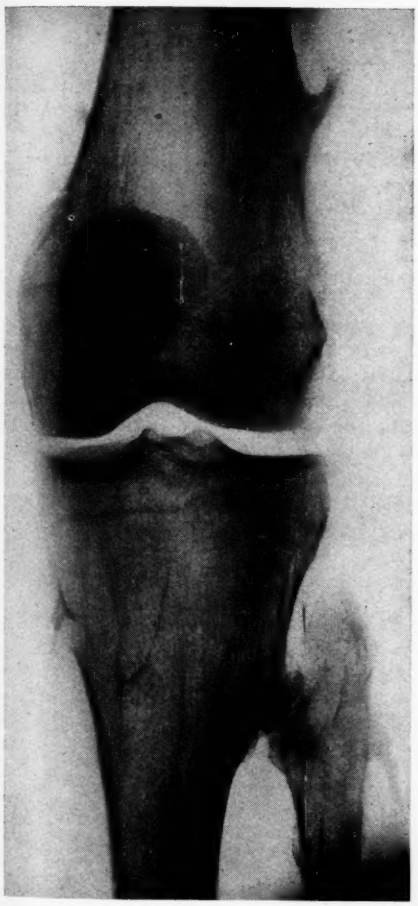


Fig. 230.—*Case* 1. Radiograph showing multiple exostoses in the neighbourhood of the knee-joint.

The condition must be distinguished from the dyschondroplasia described by Ollier,[7] which sometimes bears a gross resemblance to it, but which is characterized by the presence of masses of endosteal cartilage in the metaphysial regions; though these may be expanded, they are less so than in diaphysial aclasis and have not the same irregular surface with exostoses. Ollier's disease is frequently unilateral, or almost so, and therefore shows a much more pronounced tendency to inequality in the length of the limbs.*

In many instances in the literature there is confusion between the two conditions and the reader finds difficulty in arriving at a differentiation; even the coexistence of these conditions in the same patient has been described,[4, 10] and it has been suggested that there is no essential difference between diaphysial aclasis, Ollier's dyschondroplasia, and multiple chondromatosis of the hands and feet.[8] In the present paper it has been thought desirable to differentiate diaphysial aclasis as strictly as possible from other conditions.

The anatomical changes progress slowly until growth is complete, and then become stationary. The following two cases, however, illustrate a rare complication, malignant change, which may occur after growth has finished.

* The clinical differentiation between these conditions is more fully considered in a paper by Hunter and Wiles.[7]

CASE REPORTS

Case 1.—The patient, a housewife aged 25, complained of swelling of the left leg, a lump in the left groin, and pain in the lower part of the stomach. "All her life" she had had bony lumps at the ends of many of the long bones (and two over vertebræ). (*Fig.* 230.)

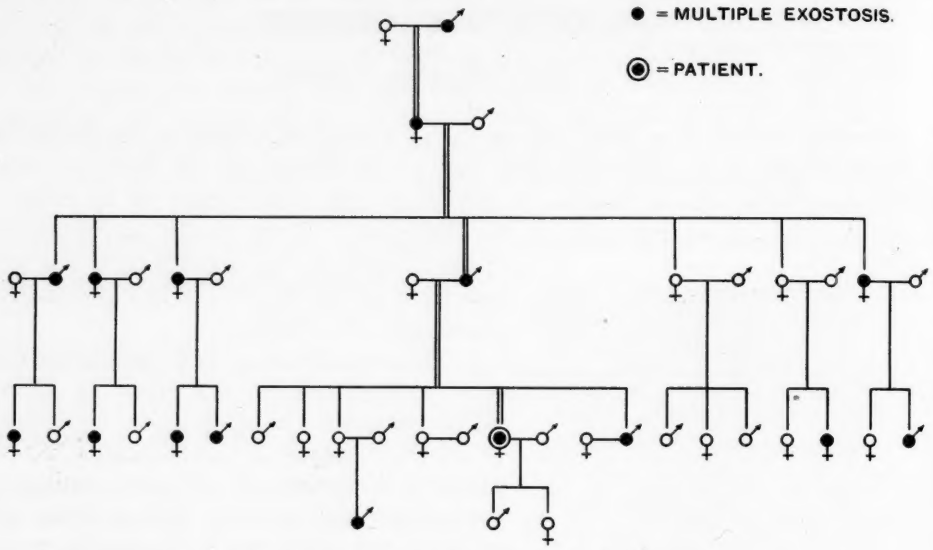


FIG. 231.—*Case* 1. Diagram of the family history.

HISTORY.—Twenty-eight months previously her second child, a daughter, was born, and four months later a lump in her left groin appeared to be increasing in size. Eleven weeks before admission she had an attack of pyelitis, which appeared to be due to compression of the left ureter by a pelvic tumour. After three weeks she recovered and noticed that her left leg became swollen and painful when she walked, but that both symptoms were relieved by rest. During the subsequent seven and a half weeks the condition of her leg became more severe, and during the latter part of this period she had a further attack of pyelitis, lasting about a week. She had been up and about for three days after this when suddenly she had nausea and vomited, and suffered with a severe pain in the lower part of the stomach, which was brought on by sitting down.

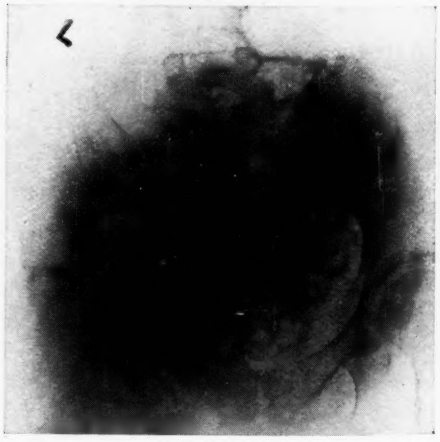


FIG. 232.—*Case* 1. Radiograph of the pelvic tumour.

Until her first attack of pyelitis her health had been good, although she had lost thirty pounds in weight during the previous four years.

FAMILY HISTORY.—This is shown in *Fig.* 231.

ON EXAMINATION.—The cutaneous veins over the left knee and the abdomen to the level of the umbilicus were enlarged, and the direction of the blood-flow was upwards: the skin was normal in other respects. Superficial to the inner third of the left inguinal ligament was an oval swelling, 4 × 3 in., which was attached to a large mass occupying the left iliac fossa and the left side of the pelvis. This mass had definite edges and a bossed surface, and its consistency resembled cartilage. Vaginal examination, which was very painful, showed that the uterus was displaced to the right

and that the tumour was attached to the left pubic bone. Movements of the left hip were painless, and except for full flexion were of normal range.

The radiograph (*Fig.* 232) shows the size of the tumour and its degree of calcification.

A biopsy was performed and the tumour was found to be encapsulated: a section of the material removed showed that the growth was interspersed with fibrous tissue, that the cells were irregular in size and shape and showed mitoses, and that there were areas of myxomatous degeneration. The diagnosis of chondro-sarcoma complicating diaphysial aclasis was made.

TREATMENT.—A course of deep X-ray therapy was given, and this caused some improvement in the local condition.

COURSE.—One year later the patient appeared to be moribund; the tumour was softer than previously. After a lapse of a further year she felt better despite the fact that the tumour was now very much larger. Six months later she died of heart failure in a condition of extreme emaciation, having suffered during the last two weeks of her life with uncontrollable vomiting.

No post-mortem examination was made.

Case 2.—The patient was a clerk aged 18, and complained of a swelling of the right thigh. Since birth he had had bony lumps at the ends of many long bones; and although five or six operations had been performed to remove such exostoses as impeded full movements of the neighbouring joints, those at the upper end of the femur had never been interfered with.

HISTORY.—Three years previously he had bruised his right thigh in a bicycling accident, but sustained no other injury. Six months later he noticed a small lump at the site of the previous injury, and this increased in size without pain until he came under observation. His health had always been very good.

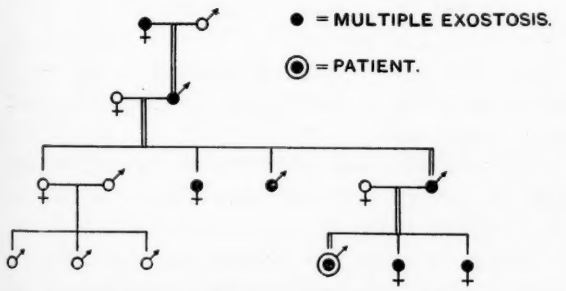


FIG. 233.—*Case* 2. Diagram of the family history.

FIG. 234.—*Case* 2. Radiograph of the tumour on the inner side of the thigh.

FAMILY HISTORY.—This is shown in *Fig.* 233.

ON EXAMINATION.—On the inner side of the upper part of the right thigh there was a large spherical mass about one foot in diameter, which expanded the thigh. In the over-lying skin, which was stretched though not attached to the mass, there were many large veins. The tumour, which was painless, was attached on its deep aspect to the femur. The surface was slightly nodular. The consistency varied, being elastic in some places and bony hard in others. The movements of the hip were limited only by the size of the tumour, which is shown in the radiograph (*Fig.* 234). No radiological evidence of metastases was found in the lungs.

TREATMENT.—Amputation was refused. A course of deep X-ray therapy was given which caused painful trophic changes in the surrounding skin.

COURSE.—Three months later a radiograph showed that there was an increase in the calcification of the tumour, which had not increased in size, and that its outline had become more clear.

CASES IN THE LITERATURE

Boyer[1] described the case of a girl, aged 20, who came under his care in 1810, complaining of a very large and painful mass in the middle of her right thigh. The patient herself and many of her relations exhibited multiple exostoses. Neither puberty nor her first four pregnancies affected the growth of any of these exostoses, but during her fifth pregnancy, and after the delivery, an exostosis, which had previously been growing very slowly, commenced to increase rapidly in size. The rate of growth was accelerated during a further pregnancy. On examination it was found that, though the tumour had extended to the knee and prevented full movement, it had not infiltrated the joint cavity or the tibia; the consistency varied from that of cartilage to bone. The limb was amputated at the junction of the upper and middle third of the thigh, and the patient was alive 18 years after the operation.[10]

Creyssel and Peycelon[4] discussed the case of a man, aged 47, who suffered from hereditary multiple exostoses, one of which, situated in the right thigh, started to grow rapidly when he was 45 years old. This was removed and no malignant change was discovered. Two years later a very large tumour involved the whole of the right thigh but not the hip-joint, and on microscopic examination after death this was found to be a chondro-sarcoma.

Nehrkorn[11] has reported the case of a man of 45 whose condition was complicated by the presence of telangiectasis at the upper end of each tibia and in the feet. He came under observation on account of a large chondroma of the little finger. He had many metaphysial exostoses, and the left leg was 14 cm. longer then the right. One year later he came with a large tumour attached to the head of the right fibula. His leg was amputated, and it was shown histologically that an exostosis had undergone neoplastic degeneration.

Hyndman[8] described the case of a man who was 48 years of age. He was born with short limbs and was unable to extend either forearm fully. When 14 years old bony lumps appeared at the ends of many long bones, and these grew slowly for some years. At the age of 47 his right hip became painful, and an exostosis on the upper end of the femur started to grow rapidly. A diagnosis of osteo-chondro-sarcoma of the neck of the right femur with a pathological fracture was made after X-ray examination. A similar condition was found to be commencing in the lower end of the same bone. A course of deep X-ray treatment was given and the condition improved.

Didier[5] described a woman, aged 31, with hereditary multiple exostoses, five of which were removed by operations. At the age of 29 a thoracic exostosis, which had not been interfered with previously, commenced to increase rapidly in size. This was excised and shown to be a chondro-sarcoma. A large soft recurrent mass, which appeared shortly afterwards, was removed, and deep X-ray treatment was given. Despite this, however, a fibrosarcoma appeared quite soon, three inches below the scar of the previous operation.

Lenormant and Lecène[10] have collected and summarized twenty-two cases in some of which the condition resembled that under discussion in this paper. In others it appears that there is no suggestion of a malignant change; in yet others, it does not seem that the condition was sufficiently proven to be included in the present paper, with the possible exception of one of Virchow's cases, in which

a woman of 28, who had exostoses on many long bones and on the base of the skull, developed on the sixth rib of the right side an enormous chondroma which 'invaded' the right lung and diaphragm.

The case of a man of 45, who had "always" had multiple exostoses and who developed a large chondroma on the right leg which became calcified and finally ulcerated through the skin, is described by Braune.[2]

DISCUSSION

The following discussion is based on the 7 cases from the literature together with the 2 here reported. With so small an amount of material available, the views expressed can be only tentative.

Pathology of the Tumour.—The pathology of this interesting condition has been discussed by many authors, for it provides a possible clue to the origin of malignant disease. The definitions of malignancy are very varied; in the case of a cartilaginous tumour it is notoriously difficult, and in practice the tendency is to rely upon rapid enlargement or local recurrence after removal as indications of this. Hyndman,[8] writing in this connection, insists that metastases should be the sole criterion. A consideration of the cases described in the literature and in the present paper suggests that the tumours with which we are concerned must be regarded as locally malignant, and as having no apparent tendency to early metastasis.

The origin of the cartilage forming these tumours is uncertain, since the cartilage caps of the exostoses should have disappeared by the time adult life has been reached. Possibly it is derived from '*restes*' resulting from irregular and incomplete ossification.

Geshickter and Copeland[6] compute that many (7 per cent of all) osteochondromata undergo malignant change, but this view is not corroborated by other writers. They mention, without giving any details, two cases of malignant change occurring in multiple exostosis, but in at least one of them the patient was suffering, not from diaphysial aclasis, but from Ollier's dyschondroplasia.

Creyssel and Peycelon[4] suggest that all cartilaginous tumours occurring in diaphysial aclasis are malignant; on the other hand, Lenormant and Lecène[10] say that the exostoses may either give rise to benign secondary chondromata, or that they may undergo a malignant neoplastic degeneration. Presumably these secondary enchondromata may undergo a malignant change such as occurs not infrequently in primary chondromata, as in the case reported by Canigiani.[3]

This certainly seems to be the pathology of the case described by Creyssel and Peycelon, mentioned above, and it is very probable that a similar train of events took place in the two personal cases, for the histories are long, one of twenty-eight months and the other of thirty.

Possible Aetiological Factors.—In both Boyer's case and in the present *Case* 1, there is a close relationship between a *previous pregnancy* and the onset of sarcoma.

A history of *trauma*, occurring six months before the appearance of the swelling, is found in *Case* 2; operative interference in Creyssel and Peycelon's

case seems to have been followed by an increase in the rapidity of growth of an exostosis.

Sex and Age.—There were 4 female and 5 male patients. With the exception of *Case* 2, a boy of 18, the male patients were all between 45 and 47 at the time of onset of the symptoms, and the women between 20 and 29.

Part Affected.—Seven of the nine cases involve the long bones of the lower limb, in six instances the femur. The condition has not been reported in the upper limb.

Symptoms.—The first symptom is the apparent increase in size of a formerly quiescent exostosis. Pressure effects may follow, if the anatomical situation favours these, as in *Case* 1. Pain is not a prominent feature, and the patients may delay months before seeking advice.

Diagnosis.—The apparent increase in size of an exostosis in an adult case of diaphysial aclasis calls for a radiological examination, which will be expected to show the characteristic mottled calcification of a cartilage tumour. Since biopsy is unlikely to assist diagnosis, and has well-known potential dangers, it is probably best avoided. In doubtful cases it might be justifiable to wait for further radiography after an interval.

Prognosis.—Most of the cases in the literature, like *Case* 2, have not been followed sufficiently long for the ultimate prognosis to be known; but the suggestion is that, without treatment, it is bad, although, if the tumour affects a limb, the patients may survive for a matter of years.

Treatment.—In the belief that the condition is locally malignant the following treatment is suggested. An operable growth, not confined to a limb, will be excised reasonably widely. A growth which is confined to a limb may be similarly treated, but in most cases an amputation of the conservative type is called for. This treatment may be regarded as curative, as in Boyer's patient, who was known to be alive 18 years after the operation. If the condition is inoperable or operation is refused, deep X-ray therapy may be tried; it seems to have been of some benefit in *Case* 1 and in Hyndman's case.

SUMMARY

1. Two cases of sarcoma complicating diaphysial aclasis are described.

2. Cases from the literature are summarized.

3. The pathology is concluded to be that of a locally malignant cartilaginous neoplasm.

4. Attention is drawn to the importance of investigating patients with diaphysial aclasis who complain of sudden increase in size of one of the exostoses.

5. The prognosis is usually bad in untreated cases, although it is not incompatible with survival for several years.

6. The treatment of choice is a radical operation if anatomical circumstances permit.

In conclusion I wish to thank Professor J. Paterson Ross and Mr. S. L. Higgs for permission to publish these cases, also Miss Kirby for her help in obtaining the family history of the second case, and Mr. Jackson Burrows for his helpful interest and assistance.

REFERENCES

[1] BOYER, A., *Traité des Maladies chirurgicales*, 1814, iii, 594. Paris.
[2] BRAUNE, T., " Ueber hereditäre Exostosenbildung ", *Thèse de Halle*, 1882.
[3] CANIGIANI, T., " Ein Fall multipler Knorpelgeschwülste des Skeletts mit örtlicher sarkomatöser Entartung (Chondrosarkom) ", *Beitr. z. klin. Chir.*, 1933, clviii, 49.
[4] CREYSSEL, J., and PEYCELON, R., " Maladie ostéogénique terminée par l'Evolution maligne d'un Chondrome ", *Lyon. Chir.*, 1930, xxvii, 733.
[5] DIDIER, R., " Transformation en Chondro-sarcome d'une Maladie ostéogénique ", *Presse méd.*, 1935, xliii, 915.
[6] GESHICKTER, C. F., and COPELAND, M. M., *Tumours of Bone*, 1936, 53, 68. New York.
[7] HUNTER, D., and WILES, P., " Dyschondroplasia (Ollier's Disease) ", *Brit. Jour. Surg.*, 1935, xxii, 507.
[8] HYNDMAN, O. R., " Hereditary Deforming Chondrodysplasia ", *Arch. of Surg.*, 1930, xxi, 12.
[9] KEITH, Sir A., " The Nature of the Structural Alterations in the Disorder Known as Multiple Exostoses ", *Jour. Anat.*, 1920, liv, 101.
[10] LENORMANT, C., and LECÈNE, P., " Sur l'Association des Exostoses ostéogéniques et du Chondrome des Os ", *Rev. d'orthop.*, 1906, vii, 203.
[11] NEHRKORN, A., " Multiple Enchondrome der Knochen in Verbindung mit multiplen subkutanen Teleangiektasien ", *Beitr. z. klin. Chir.*, 1898, xxii, 800.

CARCINOMA OF THE CHEEK
AN ORIGINAL METHOD OF TREATMENT, WITH REPORTS ON TEN CASES

By NORMAN PATTERSON, London

So dissatisfied was I with the results following the treatment of cases of carcinoma originating in the mucous membrane of the cheek that a little over eleven years ago I devised a method of attack which I have employed exclusively since. The number of cases treated is small, but they are consecutive. Prior to 1926 I attempted to exercise malignant tumours of the cheek by an entirely buccal approach, using the method of diathermy excision. This proved unsatisfactory because of the varying thickness of the soft tissues of the cheek, which markedly increase in thickness as they pass backwards from the angle of the mouth to the ascending ramus of the jaw. If excision is attempted from the mucous membrane surface without the preliminary operation I am about to describe, there is great difficulty in removing sufficient tissue in depth over the whole area. The skin, especially in the anterior part of the cheek, is liable to be damaged by the heat of the terminal, and sloughing may take place with a resulting fistula, yet timidity in dealing with this anterior region will almost certainly be followed by recurrence of the tumour.

It occurred to me that these difficulties could be overcome by placing the skin out of danger before attempting excision of the growth. The operation, which I have described briefly elsewhere, and which is not undertaken till the usual preliminaries with regard to removal of oral sepsis have been observed, consists in making a skin incision which, starting at the level of the lower attachment of the pinna, is carried downwards along the posterior border of the ascending ramus of the mandible as far as its angle. From this point it follows the inferior border of the mandible till it reaches the symphysis. The incision is only skin deep, an important consideration, otherwise in its posterior part the parotid gland may be injured. The skin is now carefully dissected from the underlying structures of the cheek far enough upwards and forwards to make certain that the area of skin raised is greater than the internal attachment of the tumour. If the growth approaches the angle of the mouth, skin can be raised in this neighbourhood nearly to the margins of the lips.

The next step is to define the facial artery and vein, as they cross the lower margin of the mandible. At this point these vessels are divided between ligatures. The vessels are then dissected as far as the anterior and upper limits of the upturned skin flap, where they are ligatured, the intervening portions being excised. The removal of these comparatively large vessels is of some importance, as during the sloughing which follows diathermy excision, the risk of hæmorrhage is minimized; in none of my cases has there been any serious bleeding.

If the tumour extends far backwards on the cheek it may be advisable to excise a portion of the masseter muscle as it lies over the ascending ramus. The anterior

portion of the ascending ramus may then be removed with bone forceps, but the soft structures lying on its deep surface should not at this stage be interfered with.

The time has now come to remove the growth, but before doing so a quantity of ribbon gauze is packed between the skin flap and the underlying soft tissues of the cheek, which consist mainly of muscle and fat. By this means the skin is kept protected from danger during removal of the tumour, which is carried out by diathermy excision by way of the mouth. If the mouth is gagged widely open

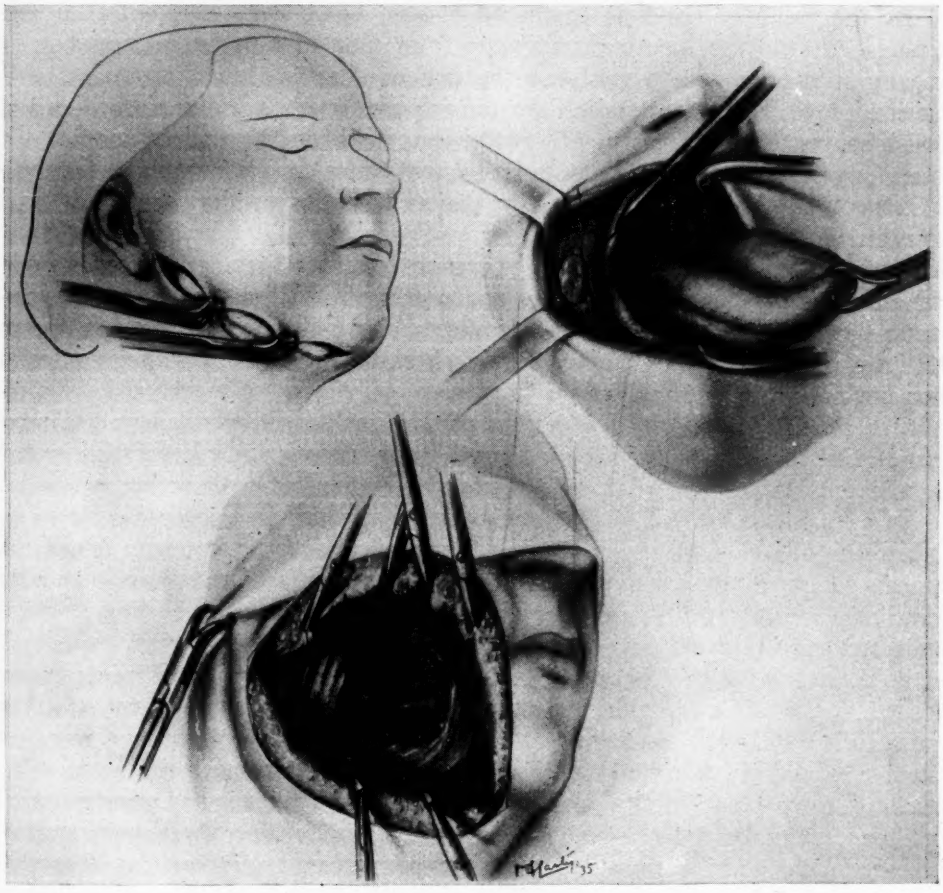


FIG. 235.—Photograph of drawings made at the time of operation, showing stages and technique employed.

and the operation field illuminated by a head lamp this will be a comparatively easy procedure. An adequate margin of healthy tissue should of course be removed with the growth. Having completed the excision, the gauze packing is withdrawn and the wound inspected from the outside. An excellent lateral view of the mouth is obtained. This method of approach is also useful where the upper or lower alveolus as well as the cheek is attacked by disease, and in some cases removal of portions of bone from these regions may be necessary, and can be carried out by the employment of cutting instruments, followed by diathermy of the bony surfaces left after excision. (*Fig.* 235.)

All that is required to complete the operation is to replace the flap and close the wound by suitable sutures.

In one patient only (*Case* 4) has sloughing caused any trouble, and this was owing to my own fault in not elevating a sufficient area of skin. In this case an opening occurred near the angle of the mouth, and a subsequent plastic operation, performed by Sir Harold Gillies, was necessary. In another patient, again owing to faulty technique, a parotid fistula resulted, but it closed in a few weeks.

As the resulting cheek is composed of skin only, care must be taken after operation to keep the mouth prized open from time to time. This can best be done by stretching with a gag, and the patient after he leaves hospital can be instructed to carry out this procedure himself two or three times a day until all fear of contraction has passed. If proper care is taken the patient should subsequently be able to open the mouth freely. My first case, which was a failure in this respect, taught me a lesson, but the patient has lived comfortably for over ten years on soft food.

In very debilitated patients the operation can be done in two stages under local anæsthesia. The flap is elevated and packing inserted and retained. A week or ten days later the tumour is removed. A two-stage operation has certain advantages in that the raw surface of the cheek-flap is covered with granulations when the time comes to remove the growth.

One of the reasons why epithelioma of the cheek has responded well to treatment is that glandular metastases seem to be uncommon; they developed in only one of my cases. In this patient I removed the glands by dissection.

In all patients treated by this method the parotid duct is destroyed in the greater part of its course. This has not given rise to any symptoms. There has been no post-operative swelling of the parotid gland; no doubt the gland undergoes disuse atrophy.

There have been no post-operative deaths.

If the skin is involved, certain modifications in technique will be necessary. In *Case* 8 the disease had spread through the substance of the cheek in the neighbourhood of the orifice of Stenson's duct. The buccal tumour was very extensive, occupying nearly all the cheek and extending almost to the angle of the mouth. At one point opposite the orifice of Stenson's duct it had penetrated the soft tissues and appeared as a nodule involving the skin. There was much swelling of the parotid gland from obstruction to the salivary flow. In this case (*Fig.* 236) a transverse incision was made from the corner of the mouth, dividing to encircle the tumour and extending backwards towards the pinna. The skin for a considerable distance above and below was dissected from the soft tissue of the cheek and gauze packing inserted beneath the upper and lower flaps. The tumour was then removed by the buccal route. It was found at the completion of the operation that the lateral opening into the mouth could not be closed. A collar incision was therefore made in the upper part of the neck and a quadrilateral flap of skin freed from underlying structures. It was found easy to slide this upwards and to close the opening into the mouth. Subsequently the neck incision healed without any further attention (*Figs.* 237, 238).

In this case it will be seen from the photograph (*Fig.* 237) that notwithstanding the removal of nearly all the mucous membrane, muscular and other tissues of the

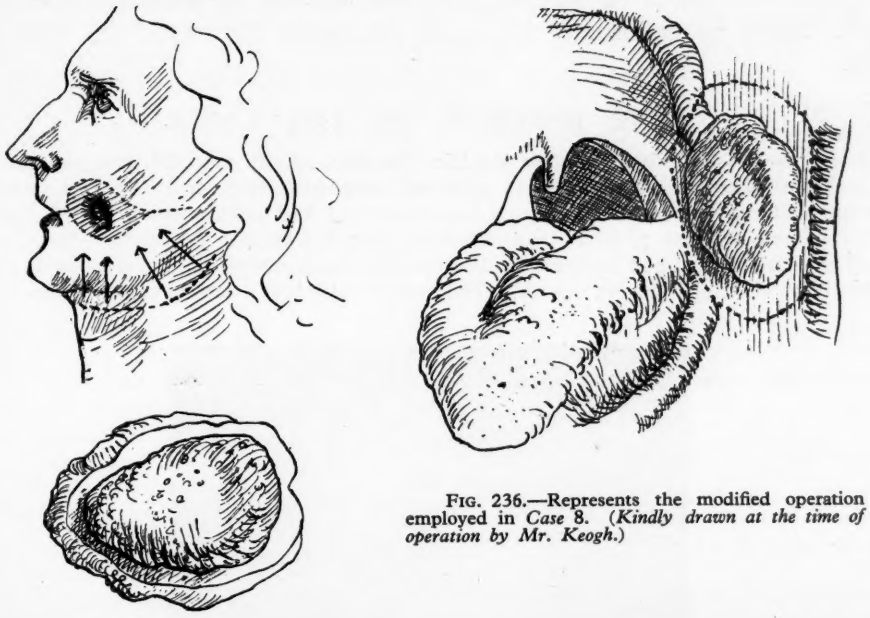


FIG. 236.—Represents the modified operation employed in *Case* 8. (*Kindly drawn at the time of operation by Mr. Keogh.*)

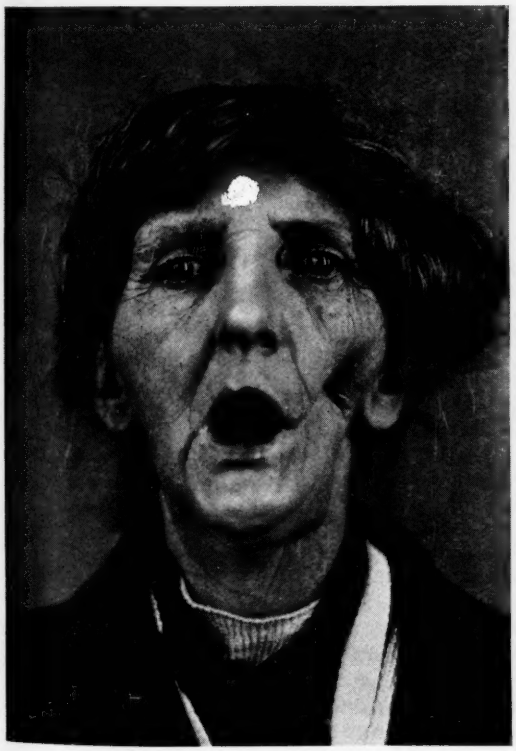


FIG. 237.—*Case* 8. Photograph taken two years after operation. In this patient a considerable portion of the whole thickness of the cheek was removed and a 'flap' was drawn up from the neck.

FIG. 238.—*Case* 8, two years after operation. Lateral view.

cheek, and a portion of the skin, there is practically no impairment in opening the mouth. Since the photograph was taken the patient has been fitted with dental plates.

CASE REPORTS ON TEN CASES

Case 1.—Miss W., age 48. Sir StClair Thomson kindly referred this patient to me for operative treatment. She was very thin and weighed only 6 st. ½ lb. and had suffered from intermittent dysphagia since 1918 for which she had been treated with bougies: I saw the patient on June 7, 1926, in consultation with Sir StClair Thomson. She then had a large growth with a broad base attached to the mucous membrane of the left cheek, extending nearly to the angle of the mouth. The patient had previously been examined by Mr.

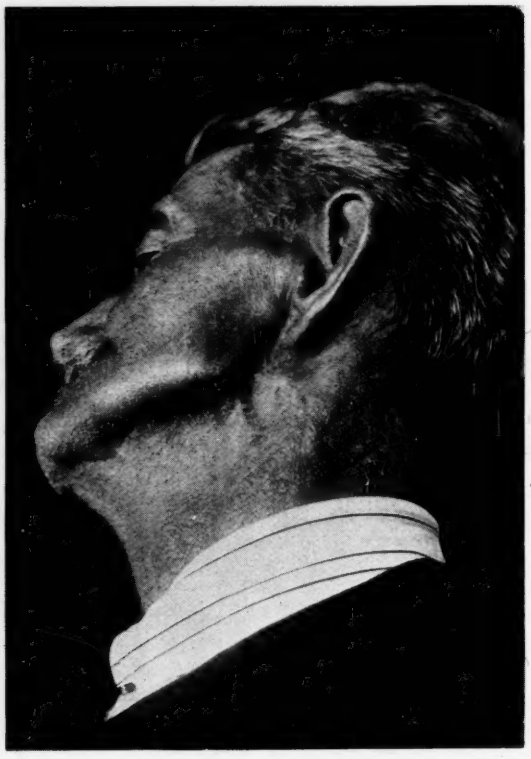


FIG. 239.—*Case* 2. Shows the scar resulting from the incision for the skin flap, and part of that for removal of the glands.

Robert Carslaw, of Glasgow, who considered the case one of epithelioma, and his diagnosis was confirmed microscopically. The growth had been treated by her dentist with repeated applications of trichloracetic acid.

On June 9, 1926, I operated on the patient in the presence of Sir StClair Thomson. A portion of the entire thickness of the cheek in the neighbourhood of the angle of the mouth had to be removed.

The patient, when examined by Sir StClair Thomson on Nov. 22, 1928, was noticed to have a small hard non-ulcerated nodule attached to the posterior aspect of the mandible in the region of the symphysis. This was removed and found to be quite innocent.

Sir StClair Thomson writes Nov. 26, 1936—ten years and five months after the operation—"Last spring she alarmed us, as X rays revealed an opacity at the base of one lung. I put her under the care of Dr. Burrell. The thing quite cleared up and proved to be only

the remains of a bronchial pneumonia. I think I reported to you that about a year ago—after a good deal of suffering—she successfully passed a calculus which threatened to be impacted in one ureter. It is wonderful how full of vitality delicate people are!" More than eleven years after operation this patient is free from recurrence.

Case 2.—A. T., male, aged 57. Seen at the London Hospital. He stated that from time to time he had noticed a painful lump in the mouth. Examination showed an indurated ulcer with everted edges on the mucosa of the left cheek.

June 30, 1926, operation. Pathological report—"squamous-celled carcinoma".

Sept. 29, 1926, the patient had developed secondary glands on the left side of the neck; these were removed by dissection and proved microscopically to be epitheliomatous.

Up to the present time there has been no recurrence either locally or in the neck (over eleven years). (*Fig.* 239.)

Case 3.—N. G., male, aged 57. Patient stated that a lump had been present in the left cheek for twelve months. His doctor had treated it by the application of carbolic. Examination showed a raised plaque on the mucosa with everted edges. My colleague, Mr. Morris, treated the case twice by the local application of diathermy on Nov. 8 and Dec. 3, 1926. Recurrence took place and he referred the patient to me for excision by the flap method. On Dec. 29, 1926, this was carried out. The pathologist reported—"squamous-celled carcinoma".

There has been no recurrence (nearly eleven years).

Case 4.—Mrs. W., aged 60. Kindly referred to me for operation by my colleague, Mr. Wheeler. This lady had been previously treated in Ireland with radium for a carcinoma of the left cheek, but the condition had recurred, and when I saw her there was an extensive ulcer which involved the lower part of the mucous lining of the cheek and adjoining lower alveolus. It approached uncomfortably near to the angle of the mouth. The growth was removed in February, 1929, and the patient remains alive eight and a half years after the operation.

Case 5.—E. C., female, aged 39. This patient had a five-months history of a swelling on the inner side of the right cheek. Examination showed a hard ulcerated mass about the size of an olive growing from the mucous membrane of the right cheek. The case was admitted to the London Hospital under Mr. Charles Lindsay, who kindly transferred her to me for treatment.

May 25, 1931, operation. Pathologist reported—"squamous-celled carcinoma".

April 26, 1932, re-admitted with facial neuralgia. She saw Dr. Russell Brain, who found signs indicating extension of the growth to the neighbourhood of the gasserian ganglion. On April 30 Mr. Hugh Cairns divided the sensory root of the 5th cranial nerve, but shortly afterwards she died.

Case 6.—R. B., female, aged 70. The patient had a three-months history of gradually increasing swelling in the region of the upper lip. Sir James Walton examined the patient and removed a portion of the growth for section and it proved to be a squamous carcinoma. He kindly referred the patient to me for treatment. On examination I found a growth about 1½ in. in diameter involving the lateral part of the mucous membrane of the cheek, upper lip, and the adjoining alveolus.

Nov. 28, 1934, growth removed.

The patient's doctor reported that the patient had died of lobar pneumonia on July 7, 1935. There were no signs of recurrence.

Case 7.—J. P., male, aged 62. (Transferred from Sir James Walton.) Six-months history of a swelling inside the mouth. An irregular ulcer about two inches in length was situated on the mucous membrane of the left cheek and the adjoining upper alveolus. There were no palpable glands.

Sept. 5, 1934, operation. Pathologist reported—"squamous carcinoma".

The patient remained well for nearly three years after operation. It is remarkable that he recently came to hospital complaining of his right cheek. On examination an epithelioma (microscopically verified) was found on the inner aspect of the right cheek. This was treated by the same method, and the patient has made a good recovery from the operation. There was no sign of recurrence on the left side.

Case 8.—Female, aged 55. This patient was referred to me by Dr. Gibson. For two years she had noticed a small pimple on the inside of the left cheek. It gradually enlarged. A fortnight before examination a sinus appeared on the skin surface. The patient said she had lost weight but she felt well. On examination, Oct. 19, 1934, there was a large firm mass attached to the mucous membrane of the left cheek: it extended to within half an inch of the angle of the mouth, upwards and downwards nearly as far as the corresponding alveoli, and backwards to the ascending ramus of the lower jaw. There was an external sinus with an indurated edge, corresponding in position to the surface marking for the opening of Stenson's duct. The left parotid gland was swollen. The growth had in penetrating the cheek evidently caused obstruction in Stenson's duct. No glands were palpable. (*See Figs.* 236–238.)

Oct. 31, 1934, the growth was removed as described above by a modified technique. Microscopic report—" squamous-celled carcinoma ".

Difficulty in opening the mouth increased, and on Dec. 30, 1934, during forcible stretching under anæsthesia, fracture of the left horizontal ramus occurred. The patient has never been told of this and she manages to open the mouth very well (*see Fig.* 237).

She remains free from recurrence (two years and nine months).

Case 9.—K. M., female, aged 69. Kindly referred to me by my colleague Mr. A. M. A. Moore. History of a lump inside the right cheek for two months. Examination showed an ulcer with everted edges one inch in diameter on the inside of the right cheek extending to the upper alveolus.

March 20, 1935, operation. Microscopic report—" squamous-celled carcinoma."

March, 1936 (one year after operation), patient died of pneumonia, no recurrence noted.

Case 10.—C. D., male, aged 71. Two-months history of increasing swelling of the inner side of the right cheek. Examination showed an ulcer with indurated base, half an inch in diameter, on the inner side of the right cheek. On account of the patient's age, and the fact that he was suffering from chronic bronchitis and emphysema, Dr. Horace Evans advised treatment with X rays or radium.

Jan. 8, 1935, 6 × 3 mg. radium needles inserted for five days, total of 2160 mg.-hr.

April 21, 1936, readmitted with recurrence of the disease in the cheek and extension to the alveolar margin. Considerable limitation in opening the mouth. Owing to the patient's poor general condition it was decided to operate under local anæsthesia, and this was done in two stages. On April 22 the skin of the cheek was raised in the usual manner and the facial vessels resected. Gauze packing was then inserted and the skin incision closed with sutures over the gauze, which was left in position. A fortnight later the growth was excised by diathermy and the gauze removed by the buccal route. Pathologist reported—" squamous carcinoma ". The patient remains well (one year and four months).

Cancer of the tongue, floor of the mouth, and bucco-pharynx is much more common in men, and it is remarkable that in this short series 6 out of 10 patients should be women. Two patients have lived for over 11 years, one for nearly 11 years, one for $8\frac{1}{2}$ years. Only one case of recurrence ensued. Unfortunately two patients died of pneumonia, but so long after treatment that neither the disease nor the operation was in any way responsible. Seven patients still enjoy good health. There was no operative mortality. In view of these results I should in every suitable case advise operative treatment rather than any form of radiation. Post-operative radiation might, however, be desirable in certain types of growth.

In all patients except *Case* 1, where it was necessary to remove a portion of the whole thickness of the skin in the region of the angle of the mouth, and in *Case* 8, where two flaps instead of one had to be formed, the skin flap method as described above was employed.

When healing has taken place the cheek on the operated side resembles closely the normal cheek, and patients do not complain of food lodging at the side of the mouth.

CONGENITAL ARTERIOVENOUS COMMUNICATIONS WITH A REPORT OF TWO CASES

By JOHN GILMOUR
HONORARY SURGEON, ROYAL VICTORIA INFIRMARY, NEWCASTLE-UPON-TYNE
AND MASON BOLAM
HONORARY ASSISTANT, SKIN DEPARTMENT, ROYAL VICTORIA INFIRMARY, NEWCASTLE-UPON-TYNE

EXAMPLES of the condition of so-called congenital arteriovenous aneurysm are sufficiently rare to be worth reporting. Two cases have recently come for treatment. The first was seen by one of us (M. B.) in the Skin Department and was ultimately treated in a Surgical Clinic at the Royal Victoria Infirmary, whilst the second was a private patient.

The first illustrates the onset of signs and symptoms after a possible trauma, and is noteworthy because of its association with hypertrophy of the affected limb. It is in fact an example of the clinical syndrome which Parkes Weber[1] has called "congenital phlebarteriectasis and hæmangiectatic hypertrophy of the limb", although there is no clinical proof that it was congenital in origin. The second case became manifest in middle life without any antecedent trauma or clinical history, and there was no hypertrophy of the affected limb.

The fact that the local vascular changes were the same lends interest to these cases and raises the question of the underlying cause.

CASE REPORTS

Case 1.—G. F., aged 13, was seen first at the Skin Department in December, 1934, when he appeared to have an inflammatory condition of the skin between the toes and on the dorsum of the left foot, which had been present for one month.

On detailed examination an indolent ulcer was seen on the medial aspect of the second toe outlined with blackened skin and containing a black slough. The dorsum of the foot was purple in colour and showed vesiculation, crusting, and superficial ulceration. One very prominent vein was seen passing down anterior to the internal malleolus.

Dressings of starch as a poultice followed by an ointment containing Lassar's paste mixed with ung. zinci oleati were advised, and the acute condition responded steadily to this form of treatment. There always remained a slight superficial loss of tissue, and the deeper ulcer of the second toe refused to heal up.

On April 23, 1935, a radiograph showed some periostitis involving the proximal phalanx of the second toe of the left foot, and the clinical appearance suggested tuberculosis, so he was asked to attend for artificial sunlight treatment, and dressings of eusol were commenced.

In August the ulcer and foot were slightly worse if anything, and the dressing was changed to crystal violet 0·5 per cent in spt. vini meth. and aqua dest.

On Oct. 22 a further radiograph demonstrated marked bone destruction of the proximal and middle phalanges of the second toe and the radiologist added the remark, "Is this tuberculous?" A Wassermann reaction taken at this time gave a negative result, and as the condition appeared to be worse rather than better it was decided to obtain a surgical opinion as to the advisability of amputation of the toe or part of the foot.

SURGICAL NOTES.—When first seen in the Surgical Out-patient Department it was elicited that the boy had hurt his left foot in August, 1934, when he fell from a tree. He

felt a stabbing pain in the region of his second toe and this recurred from time to time. About four months later this toe became purple, and this condition extended to the adjoining toes and dorsum of the foot. He was then sent to the Skin Department.

When he came to the surgical side the condition of the foot was as shown in *Fig.* 240. The dorsum of the foot and the four inner toes were covered by a purple 'nævoid' condition, with local vesiculation and crusting, and there were two indolent ulcers, the larger on the outer side of the second toe and the other on the outer side of the big toe near the web. It was thought that the "periostitis" of the first phalanx of the second toe might have resulted from a fracture sustained when he fell from the tree. In addition, it was noticed that the veins of this foot and leg were distended, and when hanging down there was pulsation

FIG. 240.—*Case* 1. Showing the appearance of the left foot.

FIG. 241.—*Case* 1. Showing the difference in length of the two legs and the pelvic obliquity.

in them. There was also some abnormal fullness in the ball of the toes, especially near the second and third. Auscultation over the femoral artery in the left groin, and over the posterior tibial artery in the lower part of the leg, revealed a distinct systolic bruit. There was also a slight enlargement of the left side of the heart, but the electrocardiogram was normal. A diagnosis of congenital arteriovenous aneurysm in the foot was made and the patient was admitted for further investigation and treatment.

Four points of importance emerged from the investigation :—

1. The local skin condition improved greatly with recumbency. During the observation period the foot was simply kept dry and elevated. All discomfort passed away. Vesiculation

and crusting disappeared, the sore on the big toe healed, and only the sloughy ulcer on the second toe remained. The cyanotic appearance of the foot and toes also diminished. It was observed, however, that it was only necessary to lower the foot to reproduce venous distension and pulsation.

2. The surface temperature of the left foot and leg was greater than that of the right, and the difference between them increased from the thigh to the foot. The following table gives a striking illustration of this.

SKIN TEMPERATURE
(Readings by Thermo-couple Method)

POSITION	RIGHT SIDE	LEFT SIDE	DIFFERENCE
Lower third of thigh..	31·6° C.	31·8° C.	0·2° C.
Patella	30·5° C.	31·2° C.	0·7° C.
Upper third of leg ..	31·3° C.	33·5° C.	2·5° C.
Middle of leg ..	29·7° C.	33·1° C.	3·4° C.
Over ankle	29·3° C.	34·7° C.	5·4° C.
Over vessels at internal malleolus	29·5° C.	36·0° C.	6·5° C.
Medial side of foot ..	28·3° C.	34·9° C.	6·6° C.
Lateral side of foot ..	26·0° C.	33·5° C.	7·5° C.
Dorsum of foot ..	29·5° C.	33·7° C.	4·5° C.
Sole of foot	25·9° C.	36·0° C.	10·1° C.
Big toe	21·0° C.	33·5° C.	11·5° C.

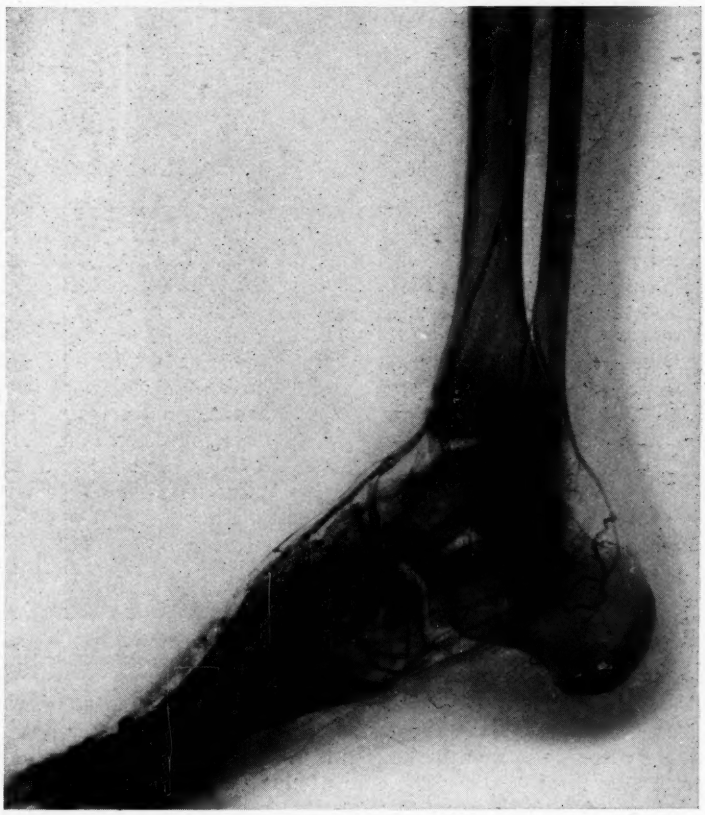


FIG. 242.—*Case* 1. Arteriogram showing the dense arteriovenous communications in the fore part of the foot.

3. The left leg and foot were found to be longer than the right. Measurement from the anterior superior iliac spine to the internal malleolus showed: Right leg, 31 in.; Left leg, 32½ in. Measurement of the feet from heel to big toe showed: Right foot, 8½ in.; Left foot, 9½ in. *Fig.* 241 demonstrates the pelvic obliquity due to the longer left leg.

4. An arteriogram was obtained by injecting thorotrast into the exposed superficial femoral artery and taking a radiograph simultaneously (*Fig.* 242). This shows a very dense network of small vessels in the region of the metatarsus and toes, with the escape of the opaque solution into the saphenous veins. No single arteriovenous communication could be distinguished, the nature of the lesion being essentially multiple.

In view of the fact that the foot was largely involved in the aneurysmal condition an amputation through the leg was done on Dec. 18, 1935. The wound healed *per primam* and there has been no subsequent trouble in the stump. The patient has since been fitted with a suitable walking stump.

At first sight it might appear that amputation is drastic treatment, but the experience of a second patient affected with a similar condition confirms the necessity for radical measures.

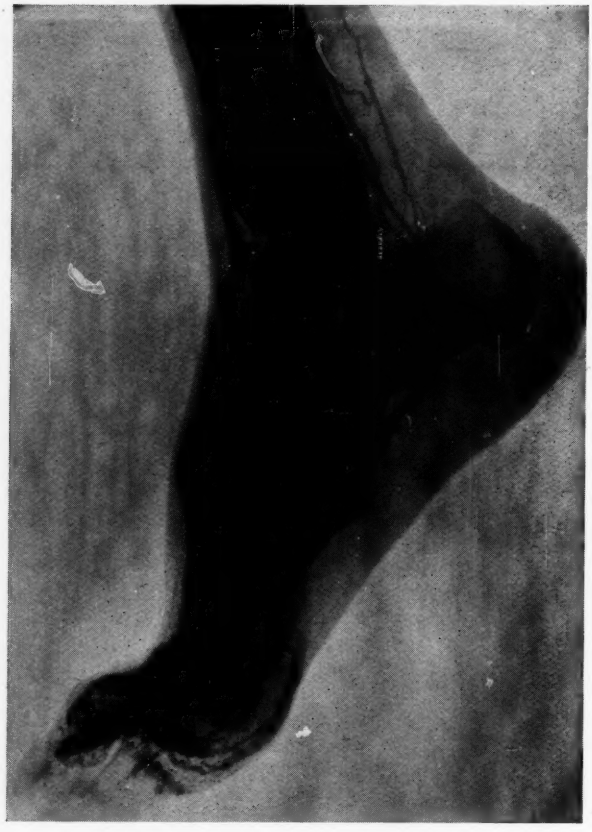


FIG. 243.—*Case* 2. Arteriogram showing the dense arteriovenous communications in the metatarsal region of the foot.

Case 2.—Mrs. H. C., aged 40, was referred for an opinion upon her right foot in May, 1935. There was a chronic ulcer on the inner side of her second toe which had resisted many forms of treatment for three years. The skin of this toe and the neighbouring third toe was purple in colour. The web between these toes was swollen, with dilated vessels, and

the fullness extended to the metatarsus above and the ball of the foot below. There were numerous dilated veins in this region, and the internal saphenous vein stood out prominently though it was not obviously varicose. When the leg hung down, as in sitting, the dilated veins pulsated visibly and palpably, and there was an audible thrill on auscultation over the lower part of the internal saphenous vein. A systolic bruit could also be heard locally over the posterior tibial artery.

The patient was healthy looking and could not account for the condition in any way. It had commenced in 1932 during pregnancy, without any local injury, and the ulcer had never healed. When she walked about there was always some pain, so she had been kept in bed for months at a time in the hope that local treatment and the rest would heal the ulcer. Her own question was, "Is it tubercular?", and amputation was desired. The nature of the vascular changes left no doubt that the ulcer was due to a so-called 'congenital' arteriovenous aneurysm. A radiograph showed general rarefaction of the metatarsal heads and of the toes, but no necrosis of bone.

The ulcer cleaned up during a brief period of observation in bed, but it retained its sloughy base.

An attempt was made early in June, 1935, to remove by local operation all the aneurysmal communications in the region of the second metatarsal bone and of the second and third toes. The skin was carefully raised from the dorsum of the foot by an incision over the second metatarsal, and all the dilated vascular and cellular tissues were dissected away from the metatarsal region. There was a considerable amount of hæmorrhage from numerous points in the raw surface which was only partly controlled by ligation of the dorsalis pedis artery. The skin was closed and pad pressure applied over the dorsum of the foot. A hæmatoma was evacuated next day. The skin edges united slowly, the cyanosis of the toes disappeared, and the ulcer healed. As an immediate result she was able to put the foot to the ground and walk without pain.

Unfortunately the ulcer remained healed for only a month, and broke down again in September. The middle toe also became gangrenous, and all the signs of arteriovenous communications reappeared. Still seeking for a remedy she went to consult several physicians, but returned in March, 1936, prepared for an amputation.

An arteriogram was obtained as in *Case* 1, and it showed a very similar condition of the vessels in the foot (*Fig.* 243).

A Syme's amputation was performed on March 14, and the stump healed perfectly.

COMMENTS

1. These two cases demonstrate the difficulty which is still experienced in coming to a correct diagnosis of the cause of peripheral ulceration. If the whole limb is obviously hypertrophied, or if there is a demonstrable degree of overgrowth, the syndrome is complete, but we have seen that this need not occur when the condition becomes manifest after bone growth has stopped. Varicose ulceration, ulceration of skin over a nævus, skin disease, gangrene, and tuberculous disease are apt to be suspected, and naturally therapeutic measures directed to these causes fail to produce a cure. Enough has been said to indicate the importance of recognizing the venous dilatation and pulsation which accompanies the condition. This is the key to a correct diagnosis.

2. The second point is the interesting association of this vascular disturbance with an increase in the surface temperature of the affected part. This might in itself suggest an inflammatory lesion, but it is worth observing that there is no general elevation of the body temperature.

3. Coupled with the thermal and vascular changes the overgrowth of bone locally is noteworthy. This is a clear indication that the condition dates from before the closure of the primary epiphyses. It was not, however, observed in *Case* 2. It has been explained as due to the stimulation of growth produced by

a state of chronic hyperæmia, assisted possibly by the local elevation of tissue temperature. Oxygen studies have shown that there is an increase in the amount of oxygen circulating in the blood which leaves the affected part, so that blood having a high oxygen tension appears to pass through the tissues where the circulation is good in superabundant quantities. No doubt this also contributes to the overgrowth of the bones.

4. But if this is true, it is also apparent that the short-circuiting of the blood-stream has a very detrimental effect upon the peripheral tissues, for they remain the site of indolent ulceration, and when there is a nævoid condition of the peripheral skin it always has a very purple hue. It seems clear, therefore, that the peripheral vessels suffer from the proximity of the wider vascular loops, and that the circulation in them is relatively stagnant.

5. The origin of the vascular dilatation is still a matter of uncertainty. In frankly congenital cases the enlargement is present at birth, but in those which are reported here there is no proof that the vessels are abnormal until the effects of that abnormality become plain. An examination of the tissues removed by dissection in *Case* 2 revealed simply a cirsoid arrangement of dilated arteries communicating with dilated veins, and the arteriograms confirmed this finding in both cases. There is nothing to suggest that the condition was due to a single arteriovenous aneurysm. If we are justified in regarding the boy's fall in *Case* 1, and the influence of pregnancy in *Case* 2, as factors of aetiological importance in the development of this type of vascular lesion, it can only mean that these events have induced locally such a degree of vascular congestion as to precipitate the development or dilatation of these vascular loops, in tissues which were potentially abnormal.

Dissection has shown that the essential abnormality lies only in the vascular tissues, and as arteriovenous communications in the form of cirsoid aneurysms or of congenital arteriovenous aneurysms have been found on the course of vessels within the skull, in the scalp, in the neck, in the subclavian region, in the forearm, and in the lower limb at various levels, it is reasonable to argue that they must have a common developmental origin.

In Pemberton and Saint's paper reference is made to the experimental research of Sabin and of Woollard on the origin and development of the primitive vessels of the chick and of the pig. They remark that " the studies of these workers appear to explain the occurrence of these arteriovenous communications on an embryological basis, since both arteries and veins arise through differentiation from a common capillary plexus."

Such an embryological explanation probably accounts for many of the vascular abnormalities which we meet. It would explain, for instance, the abnormal course sometimes taken by arteries and veins; it would perhaps account for the origin of the common capillary nævus; and it would surely be an adequate explanation of the occasional persistence of those multiple arteriovenous channels which characterize cirsoid aneurysms and the various grades of congenital arteriovenous aneurysm.

On such a basis pathological changes dependent upon the involvement of the peripheral circulation would occur earlier in the grosser examples of the condition, whilst in the more limited forms the onset of clinical signs and symptoms would be later, would be characterized by a local lesion, and might be precipitated by

any condition which either stimulated the arterial flow or impeded the venous return.

A theory of this kind is required to link together the various manifestations of congenital arteriovenous communications, for they are essentially of the same nature, though at first sight there appears to be little in common between the child with hæmangiectatic hypertrophy, and the patient with an indolent ulcer on the toe.

REFERENCES

WEBER, F. PARKES, *Brit. Jour. Child. Dis.*, 1918, xv, 13.
PEMBERTON and SAINT, J. H., *Surg. Gynecol. and Obst.*, 1928, April, 470.
HARRIS, K. E., and WRIGHT, G. P., *Heart*, 1929–30, xv, 141.
GRAY, A. M. H., *Proc. Roy. Soc. Med.*, 1927–8, xxi, 1431.
THOMSON, J. E. M., *Jour. Bone and Joint Surg.*, 1932, xiv, 702.
BLUMGART, H. L., and ERNSTENE, A. C., *Arch. of Internal Med.*, 1932, xlix, 599.
SABIN, FLORENCE R., *Contributions to Embryology, Carnegie Institute*, 1917–8, vi–vii, 61.
WOOLLARD, H. H., *Ibid.*, 1922, xiv, 139.

RECTUS TRANSPLANTATION FOR MIDLINE INCISIONAL HERNIÆ

By H. C. W. NUTTALL, Liverpool

It is common experience that a lasting 'cure' of incisional hernia is difficult to obtain; this is proved by the frequent recurrences which follow operation for this condition. As a further consequence, the number of operations and modifications of operations devised by surgeons is innumerable. It is hard to know which to admire most, the ingenuity of the surgeons or the fortitude of the patients.

Time has shown that many so-called radical cures have been far from radical; and this is not surprising, since many of these operations have not been based on sound anatomical or surgical principles. It should follow, therefore, that before submitting any new method of operation a surgeon should be prepared to show that it conforms in these respects, and if possible has been tested by time.

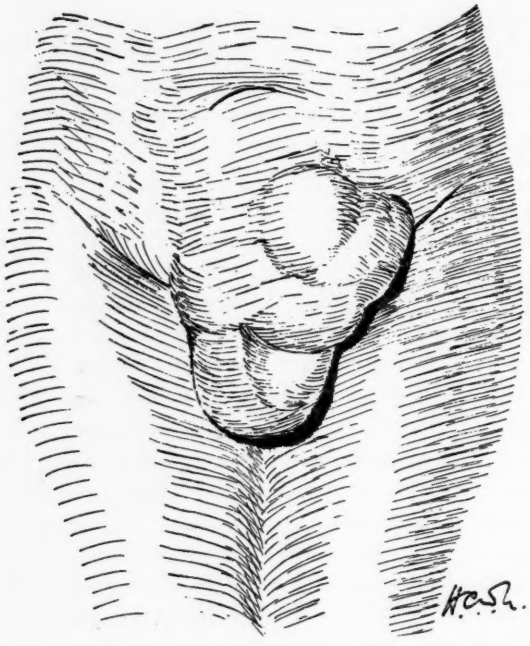


Fig. 244.—Large multilocular incisional hernia overhanging pubis.

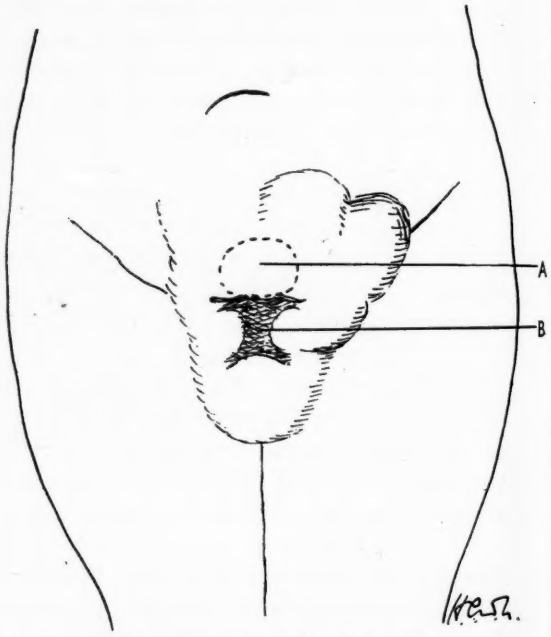


Fig. 245.—Relation of the neck of the sac to the symphysis pubis. A, Neck of sac; B, Symphysis pubis.

The problem first presented itself to me in 1925. In April of that year a widow, M. W., aged 57, was sent to me with a history of an incisional hernia following a hysterectomy in 1903. In 1921 and 1922 three operations were performed for the cure of the hernia, but it recurred within a few months after each. Owing to the further damage to the tissues, the hernia steadily increased in size, caused great distress, and prevented her from doing her housework.

When I saw her it was the size of a small football, hanging down over the vulva and resting on her thighs when she sat down (*Fig.* 244). The skin covering it was very thin and showed the scar tissue of the previous operations. Partial reduction of the contents was possible, and the neck of the sac could then be felt; it admitted three fingers, its lower margin being formed by the symphysis pubis (*Fig.* 245).

In view of three previous attempts by an experienced surgeon, further operation was not lightly to be undertaken. The problem called for something more than the ordinary methods of repair if it could be found. The chief difficulty seemed to lie in the fact that the upper border of the pubis formed part of the circumference of the neck of the sac. Any attempt to draw the tissues together on either side appeared hopeless owing to the lack of material below; and for the same reason I did not think that Gallie's recently introduced method of fascial sutures would give a sound repair.

It then occurred to me that I might utilize the recti abdominis in the line of their contraction if they were detached from the pubis and re-attached in an overlapping manner. Suffice it to say that after a visit to the dissecting room I worked out the general plan of the operation I am about to describe.

I operated upon the patient two days after; the wound healed well, and on April 23 she commenced exercises in bed. She began to get up on April 30, and was discharged on May 8. This case was published in the *British Medical Journal*, 1926, i, 138. I have seen her on many occasions since, and up to the present time, twelve years after the operation, she has led an active life and there are no signs of any recurrence of the hernia.

THE OPERATION

The patient should be so placed on the table that the Trendelenburg position can be obtained if required. The suturing of the muscles to the pubis will be found to be easier if the surgeon stands on the patient's left side.

In my first case I made a transverse incision; later I found a vertical one gave much better access. The skin and fat are reflected on either side sufficiently to expose the lower halves of the recti and their sheaths. Very often the peritoneum or pseudo-peritoneum of the sac is firmly adherent to the skin and must be separated from it, or a portion of both excised (*Fig.* 246). The sac is trimmed up and sutured; any adherent omentum or bowel is detached as necessary.

The rectus sheath is then carefully reflected from the muscle on either side, carrying the reflection well down on to the pubis (*Fig.* 247). Each rectus is then detached from its origin to the pubis and symphysis without interfering with its nerve-supply in any way (*Fig.* 248). Either of them is now stretched downwards to the opposite side of the pubis and firmly sutured to the ligaments and fibrous tissue (*Fig.* 249). If necessary, the muscle can be shortened by turning up the lower inch or so and suturing it. The opposite muscle is sutured in the same way. A series of extra sutures are then inserted along the edges to maintain apposition of the overlapped muscles (*Fig.* 250). Alternatively, the muscle can be cut through just above its origin, and in this case each muscle can be sutured to the stump of the opposite one, but this does not allow as much overlap. The sheath on either side is then brought together as far as possible—often there is some deficiency,

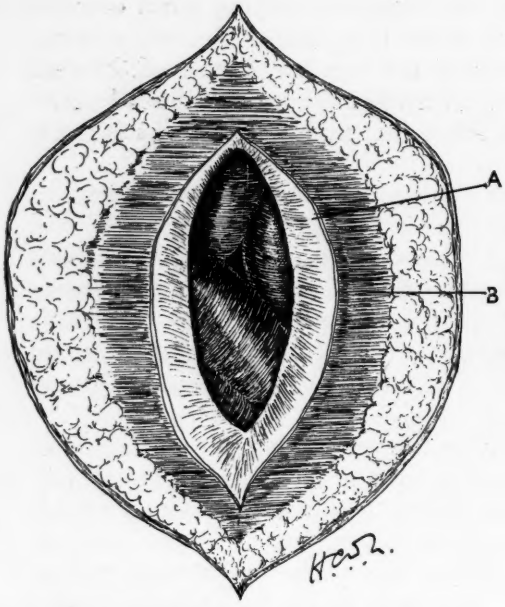


FIG. 246.—Redundant sac removed; peritoneum ready for suturing; rectus sheath exposed on either side. A, Peritoneum; B, Rectus sheath.

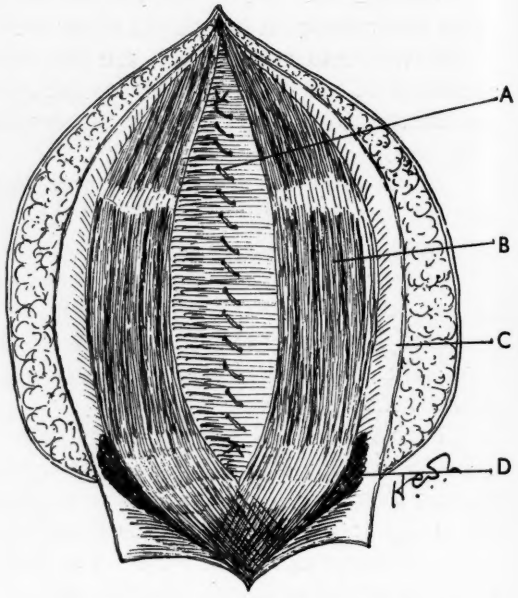


FIG. 247.—Peritoneum sutured; rectus sheath dissected up on either side to expose recti. A, Peritoneum sutured; B, Rectus abdominis; C, Rectus sheath; D, Pyramidalis.

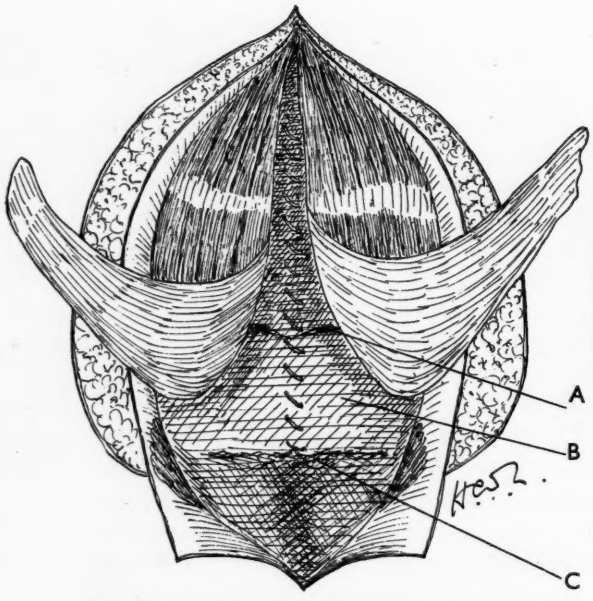


FIG. 248.—Recti detached from pubis. A, Fold of Douglas; B, Transversalis fascia and peritoneum; C, Upper edge of symphysis pubis.

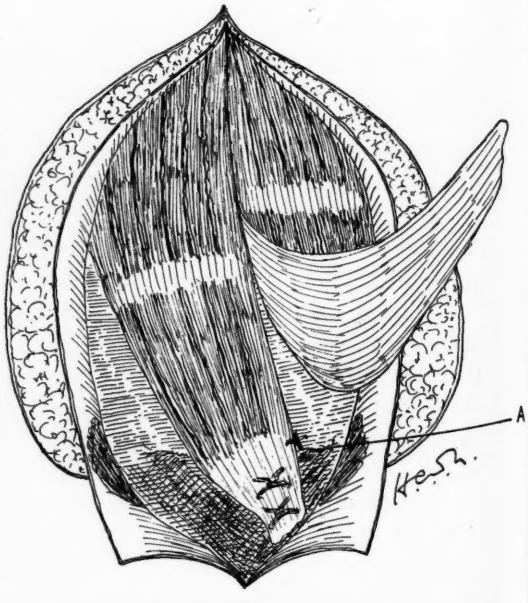


FIG. 249.—Right rectus sutured to opposite side of pubis. A, Upper edge of symphysis pubis.

but this does not impair the result (*Fig.* 251). Finally the skin is sutured and a rubber dam drain drawn through between the sutures.

After-treatment.—No special after-treatment is required apart from abdominal exercises, which I consider very important. They commence about the tenth to fourteenth day; at first the patient only tenses the abdominal muscles

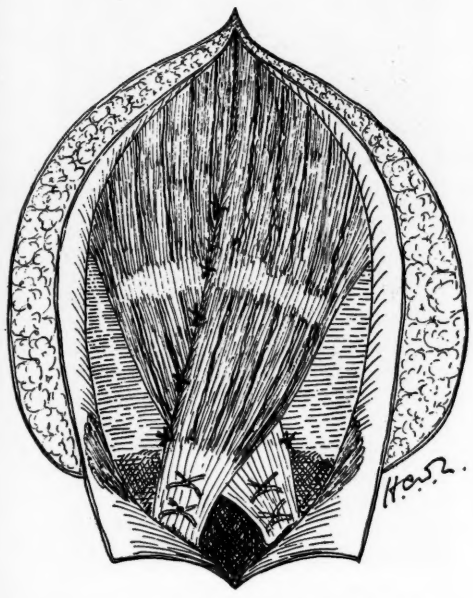


FIG. 250.—Left rectus overlapping right and sutured to opposite side of pubis.

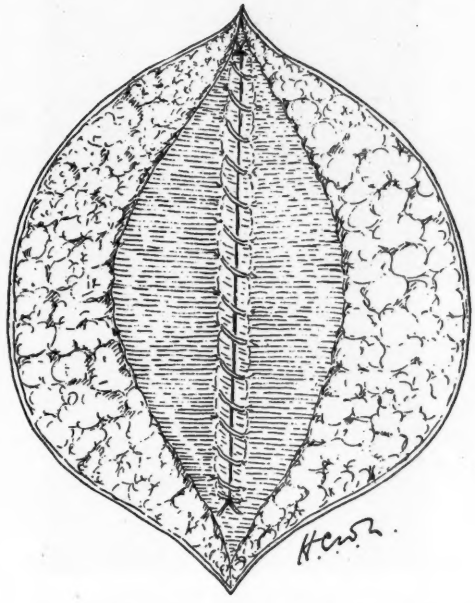


FIG. 251.—Rectus sheath drawn together and sutured.

by raising the head; gradually the effort is increased, and finally attempts are made to sit up with the arms raised so that there is no aid from the elbows. Later the extended legs can be raised on the abdomen also. I advise the patient *not* to wear a belt.

CASE REPORTS

Case 1.—Mrs. O'R., widow, age 68.

HISTORY.—Three operations elsewhere: 1917, for uterine prolapse—midline sub-umbilical incision; 1922 and 1927, for incisional hernia.

ON ADMISSION.—General condition good. Very large incisional hernia overhanging vulva; irreducible, but orifice in abdominal wall could be felt just above pubis and admitted four fingers. (*Fig.* 252.)

OPERATION (April 30, 1937).—Rectus transplantation.

Comment.—In addition to the main sac there were two fairly large loculi; numerous adhesions were present between bowel and sac; raw areas after separation of gut were sewn over.

AFTER-TREATMENT.—Fair quantity of serous discharge; wound healed on transfer to convalescent home, May 27.

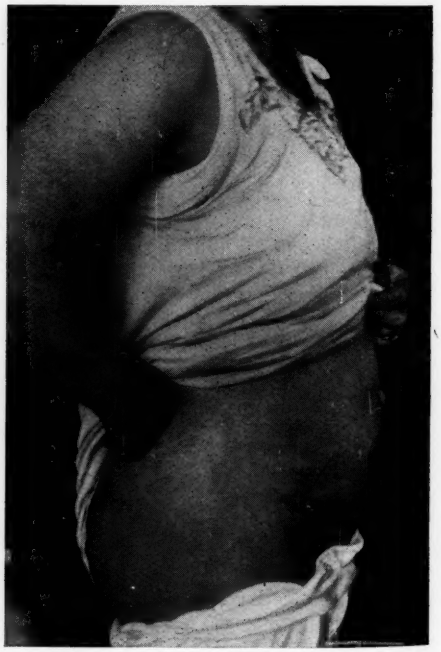
July 10, 1937: Wound remains well healed, muscles firm, and no sign of hernia. (*Fig.* 253.)

Case 2.—Mrs. E. W., age 40.

HISTORY.—Cæsarean section about 1930. Midline incisional hernia developed later.

FIG. 252.—*Case* 1. Lateral view, previous to operation.

FIG. 253.—*Case* 1. Same view, ten weeks after operation.



FIGS. 254, 255.—*Case* 2. Photographs of patient showing appearance six weeks after operation.

ON ADMISSION.—General condition good. Fairly large incisional hernia above pubis; biloculated and irreducible.

OPERATION (April 30, 1937).—Transplantation of recti.

Comment.—The upper part of the rectus sheath was deficient, but the lower portions came together.

AFTER-TREATMENT.—For the first week patient was troubled by cough; otherwise, apart from some serous discharge from the wound, which continued for a few weeks, recovery was uneventful. *Figs.* 254 and 255 show the appearance of the abdomen six weeks after operation.

July 8, 1937: Wound healed, muscles show firm contraction, and no signs of hernia.

INDICATIONS FOR OPERATION

In assessing the suitability of a case for this operation, the two chief local factors are: (1) The site of the hernial orifice in the abdominal wall; and (2) The condition of the abdominal muscles.

The orifice must be in or near the middle line; usually it is just above the pubis, and this is accounted for by the weight of the hernia dragging the neck of the sac down on to the bone. The condition of the muscles can be easily ascertained by asking the patient to raise the head whilst the fingers are pushed into the neck of the sac. In most of these cases, in spite of a pendulous abdomen, the tone of the muscles is fairly good. Some of them have very evident divarication of the recti in addition to a definite hernia. Though this divarication commences with a lateral stretching of the linea alba, either due to increasing obesity or trauma, I believe it is considerably aggravated by the lateral pull of the flat abdominal muscles, so that eventually the recti become weak from over-stretching.

Divarication is no contra-indication, since I believe this operation, or an extension of it, is the best method of restoring the normal tone of the muscles by freeing them from the lateral pull of the sheath and placing them in an advantageous position for recovery.

I suppose there must be a limit to the size of hernia, but it is really rather astonishing what large herniæ can be dealt with by this method. Two that I have operated upon had been regarded as hopelessly inoperable.

DISCUSSION

The idea of utilizing living active muscle in the repair of abdominal herniæ is not new. As long ago as 1892 Wölfler originated the idea of using the rectus abdominis in the repair of inguinal herniæ, and he was followed a few years later by Bloodgood and Halstead in America. This, however, was not a true transplantation, and, in fact, the method as described violated one of the essential principles in the transplantation of muscles, in attempting to pull the fibres of a muscle in a direction at right angles to the line of action. Later, Halstead used only the anterior layer of the sheath.

The principles of muscle transplantation have been laid down for us by orthopædic surgeons, and there is general agreement on at least five points:—

1. The nerve-supply must be preserved intact.
2. The line of action from origin to insertion should be as straight as possible.
3. The muscle should be sutured in moderate tension.
4. The muscle should be transplanted into bone if possible.
5. There should be no lateral pull on the belly of the muscle.

One question naturally arises, and that is: "What happens on the outer side of the rectus when it is detached and brought across the midline?" If it created a weakness there it might mean transforming a midline hernia into two lateral ones. As a matter of fact, this does not occur, because the sheath of the rectus remains intact on either side and retains its connection with the flat muscles. After the recti have been sutured in position, the sheath is drawn over the muscle again and pulls the flat abdominal muscles towards the midline, thus effectually guarding the areas to the outer side of the recti. This is very well seen in patients who have been operated upon, and it is quite remarkable how solid the whole lower abdomen feels when the muscles are contracted. There is no sign of weakness at the sides of the recti.

EXCISION OF THE RECTUM

By Sir HUGH DEVINE
SENIOR HONORARY SURGEON, ST. VINCENT'S HOSPITAL, MELBOURNE

Since I have learnt the great value of operating on the distal colon by the simple but safe method of operating on a distal colon which has been completely defunctioned and, furthermore, adequately prepared (a method described in the *British Medical Journal*[1] and the *Medical Press and Circular*[2]), it was only natural that I should extend this method to operations on the rectum, and in particular to those dangerous operations in which it is necessary to unite the rectum to the sigmoid. The object of this paper, therefore, is to discuss the surgery of the rectum and lower sigmoid, and to put forward some methods of operating on the rectum—methods which depend for their proper performance on the principle of operation on the defunctioned rectum.

This paper is based on the experience gained from clinical material consisting of about 60 patients, on whom rectal resection has been carried out.

Problems in the Surgery of the Rectum.—In the surgery of the rectum, the surgery of *carcinomatous growths* is the most exacting of the rectal problems, for they are of frequent occurrence, being rather more than one-third of the carcinomatous growths of the whole of the alimentary canal (Miles[4]).

The surgery of carcinoma of the rectum is, however, well worth while; for, although the operation is difficult and serious and the patient runs a high operative risk, nevertheless, if he recovers, he may in quite a majority of cases enjoy a considerable length of life; for about 50 per cent of cases of carcinoma of the rectum are of a moderate type of malignancy. Indeed, many patients on whom I have operated for carcinoma of the rectum have lived from ten to fifteen years. On the other hand, a proportion of carcinomas of the rectum are of the 'invasive' type, spreading rather quickly into the rectal wall, and invading the glands and even metastasizing to the liver. This type is not very amenable to even the most radical of operations.

A problem in the surgery of the rectum almost as exacting as that of rectal carcinoma is the surgery of *inflammatory diverticular tumour of the sigmoid*, for, in many cases, the whole sigmoid colon is involved. So that, in this disease, as well as in the case of rectal carcinoma, the great disability resulting from its surgical treatment is that the standard operative procedures render the patient incontinent, making him, as it were, a social leper. While in malignant disease of the rectum or the recto-sigmoid region there may be some excuse for this, in innocent disease of these regions there is none.

The Author's Studies in the Surgery of the Rectum.—My attention has been directed to two studies in relation to the surgery of the rectum. The first study aimed at lessening the difficulties, and therefore the dangers, of the standard operation for carcinoma of the rectum, that is, at reducing the high operative mortality, by simplifying the operation. The second sought to devise methods for the removal of the more 'benign' and more favourably situated carcinoma

of the rectum which would retain for the patient his continence, without lessening the curative results of the operation. This latter study was particularly concerned with those patients suffering from diverticular tumour of the lower sigmoid, and with those cases of carcinoma of the upper part of the rectum or of the recto-sigmoid junction, or of the lower part of the sigmoid, in which, under certain circumstances, it was possible to preserve the anal canal and the sphincteric apparatus.

The Surgical Principles involved in dealing with the Unfavourable Conditions peculiar to the Rectum.—The conditions peculiar to the rectum, which are adverse to operations and involve special difficulties, are as follows :—

1. Its septic contents.

2. The powerful muscular movements which take place in its walls when it is discharging fæcal contents.

3. Its equipment with a sphincteric apparatus, which, because of its muscular obstruction in the functioning rectum, will never allow a wound proximal to it in the rectal wall to heal.

4. Its inaccessible situation ; it is encased in the bony pelvis, and is therefore difficult of access for the manipulations required for its resection.

5. Its surrounding ' loose area ', a space like the ' loose area ' of the scalp, and necessarily capacious, because of the great variability in the distension of the rectum, and a space, therefore, readily infectible like that of the scalp.

6. The absence of rectal peritoneal covering, which, in other hollow viscera, is so necessary for the immediate closing and quick healing of wounds.

Conditions such as these, so prejudicial to the safety and success of a rectal operation, entail special considerations. These considerations largely involve operation on the rectum on the principle which I have already evolved for operations on the distal colon ; that is, the operation must be performed on, and the repair following the operation wound must take place in, a defunctioned rectum.

THE CIRCUMVENTION OF THESE ADVERSE CONDITIONS.—

Septic Contents and Muscular Movement.—The presence of septic contents and the powerful detrusor muscle movement are inseparable accompaniments of the function of the rectum. If, therefore, in the case of an anastomosis of the rectum, or where the rectum is part of an anastomosis, the operation is carried out and the anastomosis is allowed to heal in a defunctioned rectum, the evil effects on healing of these adverse conditions are avoided.

Inaccessibility of the Rectum.—The inaccessibility of the rectum is also overcome by defunctioning it, thus emptying it of its contents—air and fæces—and permitting the contraction of its walls. It is surprising to see how small the defunctioned rectum is, and how accessible and easy to dissect it is in comparison with the functioning rectum.

Better access to the rectum may also be obtained by : (*a*) Employing a special position—the ' hanging belly ' position ; (*b*) The use of a spinal anæsthetic ; and (*c*) The use of the author's operating frame.

a. The ' hanging belly ' position : Fig. 256 shows the Westhues ' hanging belly ' position for a perineal amputation of the rectum, viewed laterally. This position allows the intestines to drop out of the pelvis into the abdominal cavity, thus leaving more room in the pelvis for the dissection of the rectum. It is a decided advance

in the technique of obtaining proper access for isolating the rectum, and especially the adherent rectum.

b. Spinal anæsthesia eliminates abdominal pressure, and allows the intestines to sink into the abdominal cavity.

c. The Devine operating frame (*Fig.* 257) enables the sacral wound to be ratcheted wide open, and gives a good exposure of the rectum, thus facilitating its perineal dissection.

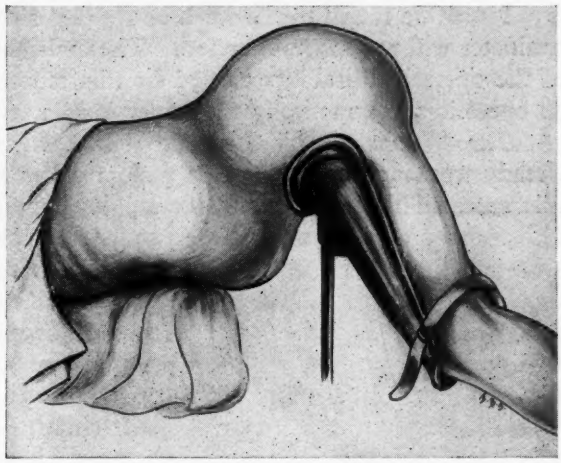


FIG. 256.—Lateral view of the Westhues 'hanging belly' position.

Absence of a Rectal Peritoneal Covering.—Difficulties in the healing of a recto-sigmoid anastomosis, which are due to the absence of a rectal peritoneal covering, can be overcome by dividing the operation into two stages: a first stage, in which the divided end of the rectum is closed and the peritoneum sutured over it; and a second stage, some weeks later, in which the lower end of the sigmoid is united to a rectal stump, over which the sutured peritoneum will have now adhered.

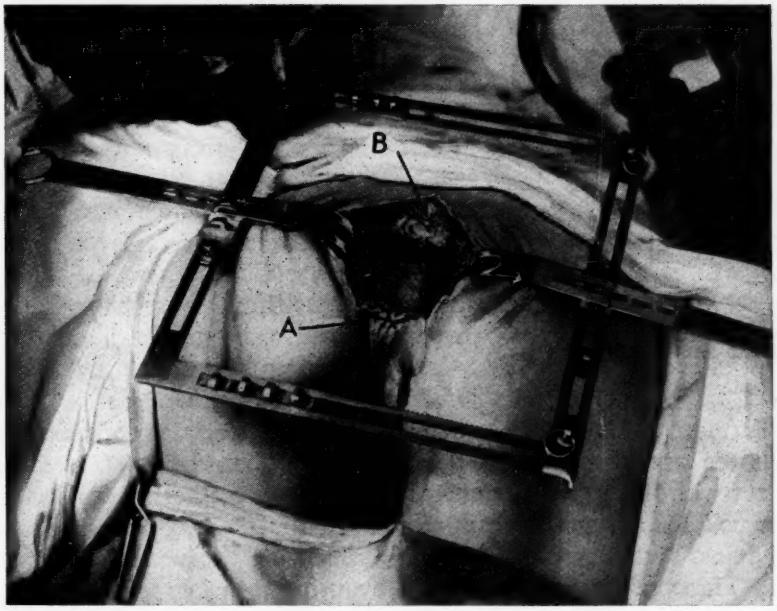


FIG. 257.—Photograph showing the use of the Devine operating frame for exposing the posterior surface of the rectum. The coccyx has been removed. A, Anus; B, End of the sacrum showing after the coccyx has been removed. The posterior wall of the rectum is exposed.

The Sphincter Control.—The sphincteric apparatus involves surgical disabilities peculiar to the rectum. These may be counteracted, first by defunctioning the

rectum; and secondly, by never—even where the rectum is defunctioned—allowing an anastomosis of which the rectum is a part to heal in the presence of an intact sphincter ani. At the time when the anastomosis is made, the sphincter muscle should be divided transversely to its fibres.

It will be found that a week or two after the rectal anastomosis has healed the sphincter will resume its function. The division of the sphincter relieves the rectum of the operative disability caused by this muscle, placing the rectum, in regard to an operation, in practically the same position as the colon.

The 'Loose Area' Surrounding the Rectum.—Considerable danger to the already weakened carcinomatous patient arises from even the slightest infection of this area. This 'loose area' around the rectum is of great surgical importance; and, after removal of the rectum, more patients than would be generally credited die from a low sepsis of this extensive absorbing surface. In the perineal operation 30 per cent of the deaths are caused by sepsis; in the abdomino-perineal operation 31 per cent are due to peritonitis (Kirschner, Pässler). In infected cases the temperature is scarcely ever high; sometimes it is hardly noticeable. The absorption of toxic products from this surface is however great, being, as in the case of an extensive burn, proportional to surface area. In the management of this 'loose area' there are three particular points to which attention must be paid.

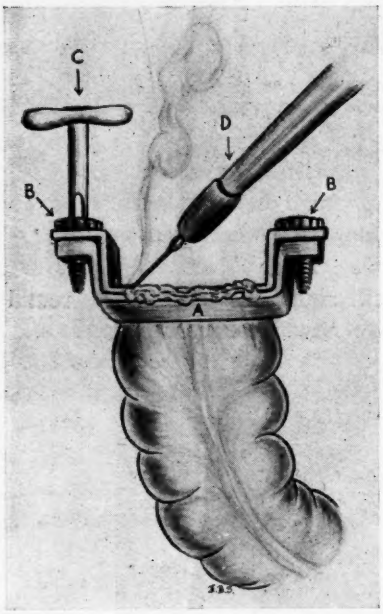


FIG. 258.—Shows the use of the box-clamp for closing the divided end of the colon. A, Box-clamp; B, Screws used to bring the two sections tightly together; C, Key inserted into screw in order to bring segments of box-clamp together with great pressure; D, Diathermy knife used to divide the bowel and coagulate its cut edges.

The first point is to take special precautions to prevent the cut end of the sigmoid—or, if the operation be started from the perineum, the lower end of the rectum—from infecting this 'loose area'. I am sure that, where the cut ends of the bowel are sutured and covered with oiled silk—the usual practice—there is an unnoticeable leakage of the septic contents, due to the squeezing of the bowel from the forcible manipulations involved when operating in a cramped space. I feel certain that this is the cause of the low infection of this space one often sees after rectal operations. The special precaution which I advocate is the use of a specially designed small 'box-clamp' (*Fig.* 258), which seals the cut end of the bowel, and, with the aid of diathermy, renders it sterile.

The second point is that precautions should be taken to prevent absorption of the tissue juices and the wound products which are the immediate result of the operation. These precautions are taken by using dressings soaked in a solution of tannic acid, which will coagulate albumin, much on the same principle as this drug is used in the treatment of burns. In addition to the use of this solution, the cavity should be packed with sponge rubber. The elastic pressure, I feel, tends to close the superficial lymphatic vessels, and thus helps to prevent absorption of tissue juices.

The third point is that the slowly healing cavity should receive regular attention in order to avoid an exogenous infection of it, a risk to which it is exposed by the long-continued dressing.

Thus, in the surgery of the rectum, it is particularly important to pay attention to the principles outlined above, the carrying out of which will enable the surgeon to circumvent the unfavourable conditions peculiar to the rectum.

THE SURGERY OF CARCINOMA OF THE RECTUM

The standard operation for carcinoma of the rectum is undoubtedly the Miles[4, 5] operation, in which the sigmoid, its mesentery, the rectum, and the anal canal are removed. It is conceived on sound lines, and will probably remain the standard operation. It is primarily an *abdominal dissection* of the rectum, and is an operation, therefore, which is attended with a good deal of shock. It is a scientifically designed operation, radical and ruthless, which leaves the patient incontinent. It is certainly the proper operation for all lowly-situated and for all unfavourable types of rectal growth. It is doubtful, however, if it should be employed for all forms of rectal carcinoma, many forms being relatively benign.

Anyway, generalizing very broadly and only from a clinical point of view, I should say that *carcinoma of the rectum may be divided into two main types*: (1) An invasive malignant type, in which the expectation of life is very poor, no matter how ruthless or extensive the operation is—that is, the carcinoma in the young, and the carcinoma which shows a definite tendency to metastasize early, and to infiltrate widely; and (2) A more benign and less invasive type of malignancy, in which the expectation of life is good—that is, the carcinoma which tends to remain local and not to metastasize in the early stages, and which, according to Westhues,[6] occurs in 45 per cent of cases.

It is (if one could be sure of one's ground) in this latter class of rectal carcinoma, especially in its early stages, that an operation less ruthless than the Miles radical operation—a ' conservative ' operation—should suffice; that is, an operation which spares the sphincter but removes almost as much tissue as the radical operation. And of this class, if one could recognize them, there are rectal carcinomas in which the expectation of life is extremely good—we have all seen patients with rectal carcinoma, who, with the help of a colostomy, have lived six, seven, and eight years. In such cases, radical operation is quite unnecessary, and a ' conservative operation ' should always suffice.

Thus, the surgeon may, in special circumstances, use his knowledge of the peculiar pathology of carcinoma of the rectum in order to avoid performing extensive standard operations which sacrifice the sphincter. According, then, to position and to its more or less invasive character, I like to approach an operation for a carcinoma of the rectum along one or other of the following lines: (1) *An abdominal recto-sigmoid resection and anastomosis*; (2) *A perineo-abdominal recto-sigmoid mobilization*, permitting a conservative operation if circumstances permit, and if they do not, a radical one.

1. **The Abdominal Recto-sigmoid Resection and Anastomosis.**—Where the growth is in the lower end of the sigmoid and its resection also involves the removal of the upper part of the rectum, I approach the operation from the abdomen, isolate and resect the diseased segment, dissecting the upper part of the rectum from above, and anastomose the divided sigmoid to the rectal stump.

2. The Perineo-abdominal Method—Radical or Conservative.—Even where the growth is low in the rectum and I know I shall have to sacrifice the sphincter, I employ a preliminary defunctioning operation which enables me, firstly, to operate on an empty and clean rectum; secondly, to begin the dissection from below, where, if I find that the growth is inoperable, I can retreat early in the operation, before I cut any important vascular connections; and thirdly, to finish the dissection abdominally so that I avoid the difficulty and delay, which occur in the abdomino-perineal approach, of incarcerating the divided sigmoid (often dilated and hypertrophied) under the pelvic peritoneum.

Where the growth is in the upper part of the rectum, and in cases where it is unlikely that the neighbourhood of the sphincter will be involved, I spare the sphincter and begin the isolation of the rectum at its junction with the anal canal, isolating the rectum and the sigmoid with its mesentery, without dividing any vascular connections, and deliver this whole vascularized recto-sigmoid segment abdominally. Having preserved the anal canal and the vessels, I am now in a position to judge whether I should carry out a *conservative* or a *radical* operation; for I can study the metastatic spread in the mesentery and the extent of the infiltration of the rectal wall; and I can see the length, and therefore the extensibility, of the sigmoid. If I feel that I can elongate the sigmoid so as to make it reach the sphincter and still remove enough mesentery and sigmoid to eradicate the disease completely (not a frequent occurrence), I perform a *conservative* operation: I divide the inferior mesenteric artery in the proper place and return the sigmoid stump to the sphincter. If, on the other hand, I find, for one or other reason, that I cannot carry out the conservative operation, I perform the radical operation as outlined above: I amputate the sigmoid with its mesentery as high up as possible, and make an abdominal anus. Thus, at the penultimate stage, when I have inspected the extent of the disease, I can make the operation conservative or radical at will.

In the case of diverticular tumour involving the whole sigmoid or its lower end, the operative approach differs from that for carcinoma of the recto-sigmoid, in that (*a*) the distal colon is defunctioned until all inflammation has disappeared, probably for from three to six months, and (*b*) an end-to-end recto-sigmoid anastomosis is made abdominally.

The carrying out of all these methods is dependent on the principle of operating on a defunctioned distal colon and rectum. Consequently, I perform what I call a *preliminary defunctioning operation*, the object of which is not only completely to exclude the distal colon and thus defunction it and the rectum, but also to explore the abdomen for any metastasis which would render the condition inoperable.

DEFUNCTIONING OF THE DISTAL COLON AND RECTUM

Main Principles Involved in Defunctioning the Distal Colon and the Rectum.—If the distal colon be disconnected from the proximal colon, and thus completely deprived of its function, this isolated recto-sigmoid segment, as a result of having lost its function, gradually loses a lot of its bacterial content. Moreover, with proper preparation (lavage, etc.) this bacterial content becomes further reduced.

Operations on this defunctioned and prepared recto-colic segment can be carried out without much danger. In conservative rectal operations, where an unperitonealized rectum has to be sutured, an operation on a defunctioned rectum

marks a distinct advance. The reason for this is that not only do the continual movement and the back pressure from sphincteric obstruction which occur in the functioning rectum prevent healing of the anastomosis, but also the unperitonealized rectum heals very precariously. Thus, primary union of a sutured wound in a functioning rectum scarcely ever takes place, death often resulting from leakage of septic contents which infect the loose area surrounding the rectum. In the defunctioned rectum, however, healing of a wound or of an anastomosis usually takes place. As the rectum has no movement, and is, therefore, at perfect rest, and moreover, as its wall is retracted, healing of a wound or of an anastomosis takes place in the same way as in any other quiescent part of the body. Further, in the absence of rectal contents, and therefore of gross infection, healing of the anastomosis is not much disturbed, even if some leakage should occur.

Operation on the defunctioned and prepared rectum, therefore, has opened up a field of surgery of the rectum which would not otherwise be possible; that is, a field of 'conservative' surgery. How often, in a rectal malignancy, we can take advantage of this is another matter!

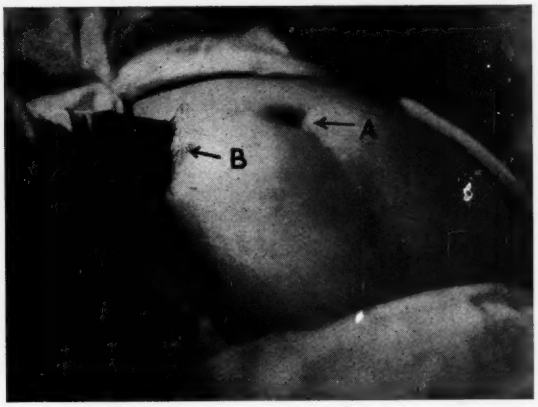


FIG. 259.—Photograph of an exploration of the abdominal cavity being made through a small incision with a vaselined gloved hand. The photograph is taken looking from the end of the table. A is the umbilicus; B shows gloved hand inserted into the small exploratory incision, into which the disconnecting anus will be inserted.

Preliminary Exploring Operation.—Advantage is taken of the defunctioning operation to make a preliminary exploration of the abdomen. As the operation is primarily intended for the making of a 'disconnecting' anus, the exploration has necessarily to be made through a small incision. It is accomplished in the following way:—

An incision a little over two inches in length is made in the upper part of the right or left rectus muscle. Its requirements are: smallness, so that there will be only a small wound to break down if suppuration should occur; and remoteness from the field of operation, so that the main field of operation is not soiled.

Exploration of the whole abdomen through this small opening is facilitated by vaselining the gloved hand, which enables an exploration easily to be made through the small incision (*Fig.* 259). It has also the additional advantage that the omentum or intestines do not cling to the lubricated gloved hand, and therefore it enables a very exact and reliable exploration of the liver and of the whole abdomen to be made.

A particular examination is made of the extent of the growth, and of any metastatic spread.

Technique of Defunctioning the Distal Colon and Rectum.—The defunctioning of the distal colon is accomplished by disconnecting the proximal from the distal colon, either at the middle of the transverse colon or at the hepatic flexure. The disconnection is made by an artificial anus.

The Disconnecting Artificial Anus.—The two main requirements in regard to this disconnecting artificial anus are: (1) It must *completely* disconnect the proximal colon from the distal colon; and (2) It must permit of the re-connection of the proximal and distal colon simply and quickly, and without inflicting an additional operation on the patient.

1. The first requirement is fulfilled by cutting the bowel across and implanting each end separately into the abdominal wall, so that an area of skin intervening between the two openings prevents the passage of any fæces from the proximal to the distal colon. The ordinary artificial anus, even if it be made with a good spur or by dividing the bowel, does not completely disconnect the bowel for long. After a short time, the spur begins to draw into the abdomen, and fæces, following the mucous membrane, pass over into, and soil, the distal segment. In my method the attachment of the spur to the block of skin prevents this soiling and ensures the complete isolation of the distal colon for any desired period of time.

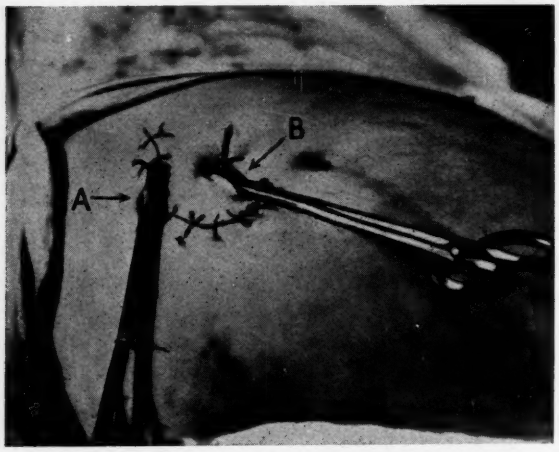


FIG. 260.—Showing the block of skin between the two cut ends of the bowel to make the disconnecting colic anus. A, Clamped proximal cut end of the bowel; B, Clamped cut distal end of the bowel.

2. The second requirement—that it must permit the easy and prompt restoration of function to the distal colon—is attained as follows:—

a. The spur is made long (about four inches). A long spur, when crushed with a long enterotome, makes a long anastomosis. The fæcal stream then naturally passes by the deep end of this anastomosis into the distal segment, rather than on to the surface as it would in a short anastomosis. The consequence is that the moment the spur is cut through, very little fæces appears on the abdominal wall, although the anus is open. Thus function is quickly restored.

b. The bowel opening is made small (about half-an-inch in diameter), and made so that its mucous membrane edges lie just under the level of the skin. The small opening suffices for the egress of the fluid contents of the proximal colon, and prevents prolapse of its rather loose mucous membrane. This smallness of the opening, and the absence of any pouting of mucous membrane, facilitate natural closing after the spur has been crushed.

The anus fulfilling these requirements is made in the following way: The long spur is obtained by suturing, for a distance of four inches, the proximal to the distal limb of the transverse colon; or, if the transverse colon be too short, by stitching the proximal limb of the transverse colon to the ascending colon. The sutured loop is then drawn up through a small opening in the upper part of the rectus muscle, divided between clamps with a diathermy knife, and the parietal peritoneum is sutured around it. The ends are then separately implanted in the abdominal wall by suturing between them a substantial block of fat and skin,

and the clamps are fixed by a silkworm gut suture to the abdominal wall (*Fig.* 260).

This disconnecting anus now serves two purposes—it completely drains the alimentary canal and thus relieves any obstruction; it defunctions the distal colon and permits of its antiseptic and aseptic preparation for resection and anastomosis.

Preparation of the Excluded Distal Colon.—The contents of the distal colon are now washed out, if possible, from the abdominal fistula. It may also be found necessary to wash out the rectum from below the growth (*Fig.* 261). Lavage with antiseptic solution helps to diminish the bacterial content. For this latter purpose, I have also used, in addition to lavage, instillations of cod-liver oil, the vitamin content of which is highly bactericidal. The length of the preparation is varied according to circumstances. In the case of carcinoma with obstruction, three weeks are required to relieve the toxic effects of the obstruction. Sometimes I have found considerable difficulty in getting the colon clean, especially after a barium meal. The barium has accumulated in a hard cricket-ball-like mass in the ampulla of the rectum. In some cases I have found it necessary to insert a stomach tube into the opening in the distal colon and purse-string it into the artificial anus, in order to get sufficient pressure of fluid in the excluded segment of the colon to wash out fæcal lumps.

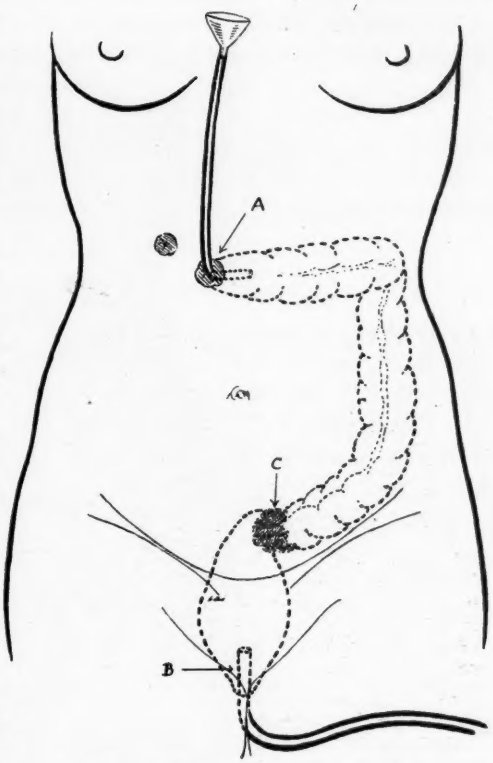


FIG. 261.—Diagram to show how the bowel is prepared by being washed out from the colostomy opening in the distal colon. A shows a tube connected with a funnel inserted in the colon. Where the obstruction is complete, the rectum is also washed out from below; B shows tube in the rectum; C indicates the position of the obstruction.

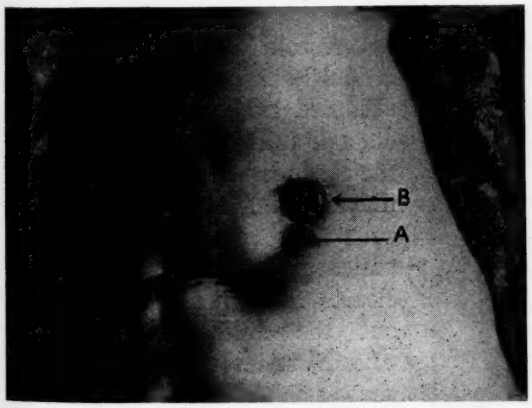


FIG. 262.—Photograph of a disconnecting anus in the left half of the transverse colon. A, Colostomy opening, which is only as big as a penholder, but acts quite well, and can easily be kept clean; B, Opening into the distal colon. This photograph illustrates how small the colonic anus can be and still be effective.

Management of the Disconnecting Anus.—*Fig.* 262 shows how small these colostomy openings can be and yet function properly. In them, control for twenty-four hours can be obtained by the use of small balloons (*Fig.* 263). One surgeon on whom I carried out

this form of colostomy, was able to control the bowel content for twenty-four hours with a toy balloon. He would then take it out, lean over a dish, empty

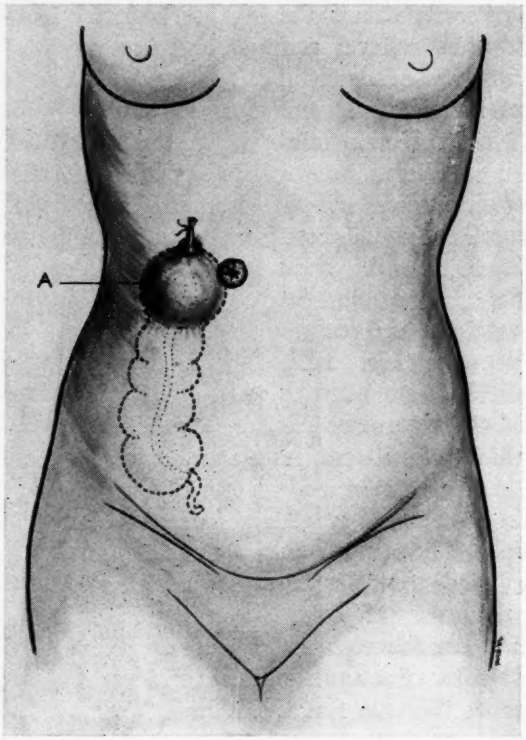


FIG. 263.—Diagram to show the control of the proximal transverse colic disconnecting anus by means of a balloon (A). A round toy balloon connected with a rubber tube is inserted into the small anus and blown up.

his bowel, clean the anus, and put back the balloon, after which he would be free from fæcal discharge for another twenty-four hours.

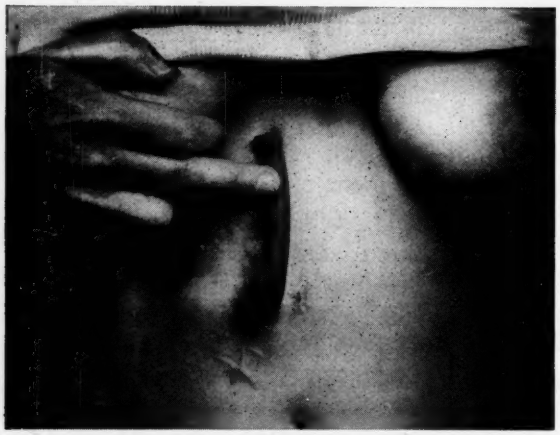


FIG. 264.—Photograph of the proximal colic anus which has been controlled by the use of an occluded tube.

Another way to control this artificial anus is to insert an occluded rubber tube of a large enough calibre to fit firmly into the opening. *Fig.* 264 is an illustration showing the use of such a tube. In this case, the patient is able to keep herself clean. Each morning she washes out the fluid contents of the cæcum, re-inserts the tube, and she remains clean till the next morning; and over a period of twelve months fæces have not leaked on to the abdomen. The small artificial anus in the proximal

part of the transverse colon where the contents are fluid, somewhat like those of the cæcum, is comparable to the opening which I am accustomed to make in the cæcum through the base of the appendix—an appendicostomy—for chronic colitis; patients have been able to keep themselves clean over a period of many years by using an occluded No. 14 catheter in these openings.

THE OPERATIVE APPROACHES FOR CARCINOMA OF THE LOWER END OF THE SIGMOID AND THE RECTO-SIGMOID JUNCTION

These are: (*a*) Abdominal recto-sigmoid resection; (*b*) Perineo-abdominal resection, radical or conservative.

The Abdominal Recto-sigmoid Resection

In the past, it was my custom to deal with cases of carcinoma of the lower end of the sigmoid or of the recto-sigmoid junction by one of two methods. In some cases, dependent on circumstances, I performed a radical Miles operation. In other cases I resected a segment containing the growth and including the lower half of the sigmoid and the upper part of the rectum. I then closed the rectal stump, covered it with peritoneum, and implanted the cut end of the sigmoid into the abdominal wall as an artificial anus. It was also my habit, in some instances, to employ the latter method for an inflammatory diverticular tumour of the lower end of the sigmoid. With both methods, however, I made the patient incontinent. I never attempted to anastomose the sigmoid to the rectum; for I knew that operations on the rectum in the presence of a functioning bowel were unsuccessful, primary union of an anastomosis always failing, and the resultant infection leading to fatal results.

Nowadays, since I have learnt that I can safely carry out these recto-sigmoid anastomoses if I make them and allow them to heal in a properly defunctioned and prepared distal colon and rectum, I have no hesitation in anastomosing the sigmoid to the rectum. I also find that, as I gain experience in this method, I can remove the rectum fairly low in the pelvis, and that I am still able to suture it to the sigmoid. Thus, being able with some degree of success to join the divided end of the sigmoid to the rectal stump in the defunctioned distal colon, I can often remove growths of the lower part of the sigmoid or the recto-sigmoid junction, and preserve continence for the patient without sacrificing the efficiency of the operation.

Steps in the Technique of Abdominal Recto-sigmoid Resection.—At a preliminary operation, the abdomen is explored, and the distal colon is defunctioned by making a disconnecting anus. It is then prepared by daily lavage. At a second operation the sigmoid is divided, between box-clamps, well above the growth, and its mesentery is also divided. These clamps are used for occluding the divided ends of the colon. Their use is illustrated in *Fig.* 258. The clamps are nearly three-quarters of an inch wide and have deep longitudinal serrations. They are closed with great pressure by means of the key. The bowel is divided with a diathermy knife, flush with the edge of the clamp. The tissue grasped in the clamp is sterilized by connecting the clamp with the coagulating diathermy current. Thus, by the use of the clamp, the ends of the bowel are so securely closed that they can be allowed to lie about in the abdominal cavity and no amount of handling of the bowel ends will bring about leakage of the bowel contents.

An additional advantage of the use of these box-clamps is that the lower one serves as a handle to the segment of bowel which is being removed.

The lower sigmoid segment held by the box-clamp is drawn forcibly upwards, and its recto-sigmoid peritoneal reflection is thus put on tension and divided. The upper half of the rectum is now isolated by dissecting it from the pelvic wall laterally, and from the bladder anteriorly, by means of long spade knife-edged dissecting scissors. It will be found that the rectum will come up out of the pelvis much farther than would be expected.

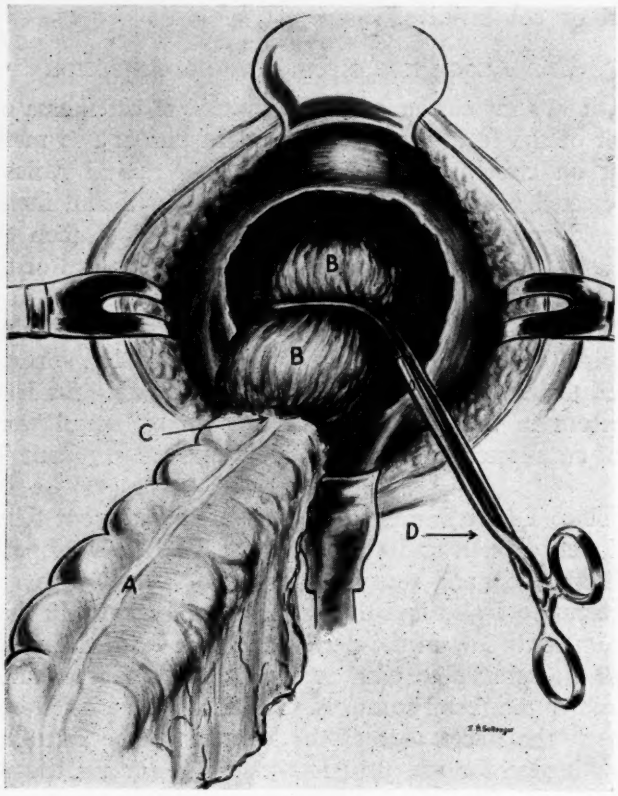


FIG. 265.—Shows the rectum divided somewhere about its upper third. A, Sigmoid; B, Rectum; C, Peritoneum which has been reflected from the recto-sigmoid junction; D, Wertheim's vaginal clamp.

The rectum is divided, in much the same way as the vagina is in the course of hysterectomy, and, as in that operation, a Wertheim's vaginal clamp is used to close the lower end of the recto-sigmoid segment (*Fig.* 265). A clamp is not applied to the rectal stump, because the tissue of its cut edges must not be crushed; moreover, its use is unnecessary, for this small segment of rectum can be cleaned easily through the anus.

In the case of a woman, the tubes should be removed, because the presence of even a slight infection (a mild sepsis occasionally occurs round the cut edge of the rectum) may give rise to tubo-ovarian abscesses.

The rectum can be joined to the sigmoid by making either a sutured or a telescopic anastomosis.

Sutured Recto-Sigmoid Anastomosis.—The lower end of the sigmoid is joined to the stump of the rectum by a sutured anastomosis, in the following way:—

The cut end of the sigmoid is examined to make sure that it is properly vascularized. It is brought down to the rectal stump, placed in the correct apposition to it, and secured in this position by guy-rope sutures, which, besides fixing the segments together, are used to anchor them to the operating frame. Interrupted sutures of fine, slightly hardened gut, taking a good third-of-an-inch bite, are inserted from the lumina of the bowel segments, which are empty and clean. These sutures are used to join the posterior and lateral walls, until it is impossible to insert any more. When this point has been reached, a few figure-of-eight sutures are inserted from the external surface of the bowel in order to complete the anastomosis. Only one layer of sutures is used.

A long needle-holder is used to insert the sutures, and another one in the left hand serves to pick them up. It is surprising to see how deep down in the pelvis the anastomosis can be made by means of this double needle-holder device. The pelvic peritoneum is sutured over the anastomosis. A tube is introduced through the abdominal wound down to the anastomosis, and another one is inserted through the rectum. The sphincter is divided.

About six or seven days after the operation, it will often be found that if saline be injected through the anus, some of it will come out of the abdominal tube. This is owing to the fact that a leak has developed in the anastomosis. The tube (or a smaller one) is therefore left in position till such time as fluid injected through the rectum shows that the anastomosis has healed. About two weeks after this, the spur of the colostomy is crushed.

As the rectum is very wide where it is divided, and as the cut end of the sigmoid can be widened by a vertical cut, the anastomosis is rather easier to make than would be expected.

The following three case histories—*Cases* 1, 2, and 3—very briefly given, show the value of this method from three points of view: (1) The feasibility and safety of a recto-sigmoid anastomosis; (2) The making operable an apparently inoperable condition; (3) The preservation of continence, which would be lost if the usual operations were employed.

Case 1.—An old and very debilitated man with carcinoma of the lower end of the sigmoid, acute intestinal obstruction, and a late stage of diabetes.

Stage 1: Disconnecting anus in the proximal transverse colon.

Stage 2: Recto-sigmoid resection with closure of the rectal stump, and implantation of lower cut end of sigmoid into loin.

Stage 3 (six months later): resection of sigmoid mucous-fistula (artificial anus) and anastomosis by suture of lower end of sigmoid with rectal stump. Recovery. Lived three years.

Case 2.—Female, aged 50 years. Diverticular tumour, intestinal obstruction.

Stage 1: Disconnecting anus made in the distal part of the transverse colon and exploration of the abdomen. A large adherent mass was found filling the whole of the pelvis, and was regarded as an inoperable carcinoma of the sigmoid.

Stage 2: Three months later, at a second operation, further scrutiny of the mass now gave the impression that it was an inflammatory diverticular tumour, and not, as had at first appeared, a carcinoma; it was, however, found to be still irremovable.

Stage 3: Six months later, at a third operation, it was seen that, as the result of six months defunctioning of the distal colon, the tumour of the sigmoid had become so much smaller and less adherent that it now appeared possible to remove it; and the whole of the

lower two-thirds of the sigmoid, which was involved in the tumour-mass and widely adherent to adjacent structures, was removed. The severed end of the sigmoid was anastomosed to the upper part of the rectum. The patient recovered with complete function. *Fig.* 266 is an X-ray of a barium clysma of this patient, made six months after the operation.

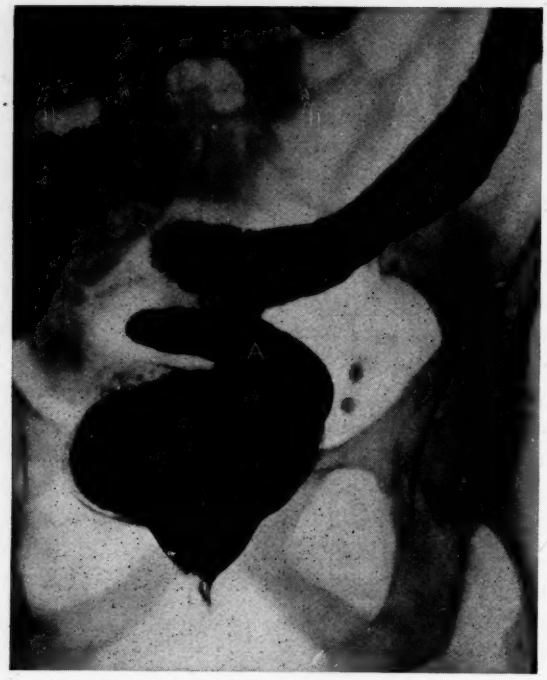


FIG. 266.—Radiograph of a case in which a diverticular tumour involving most of the sigmoid was removed, and the divided end of the sigmoid anastomosed to the upper part of the rectum. A marks the junction of the sigmoid with the rectum.

Case 3.—Male, aged 75 years, greatly debilitated, carcinoma of the lower end of the sigmoid, acute intestinal obstruction with great distension.

Stage 1: A disconnecting anus was made at the hepatic flexure (the transverse colon was short owing to the great distension), a loop being made by suturing the proximal limb of the transverse colon to the ascending colon. Exploration revealed the fact that the patient had a sigmoid growth, which, because it was adherent to the surrounding structures, including the bladder, appeared to be inoperable. Two weeks later, the patient developed complete prostatic obstruction and became uræmic.

Stage 2: Cystotomy—the bladder was connected to a continuous suction apparatus.

Stage 3 (two months later): Prostatectomy.

Stage 4 (four months after the first operation): Exploration showed a small contracted distal colon, with the growth now lying quite free (except for a slight attachment to the bladder), and apparently quite operable. A recto-sigmoid resection was carried out and an immediate single-layer sutured anastomosis was made, the union being between the upper part of the rectum and the lower end of the upper third of the sigmoid. Notwithstanding the patient's great weakness and long illness, this operation did not in the slightest degree disturb his general condition or the function of his colostomy. He recovered from the effects of the operation, but died two months later.

These cases, illustrating as they do the most difficult surgical problem involved in carcinomas or in diverticular tumours of the lower end of the sigmoid and the recto-sigmoid junction, show the particular application of the abdomino-recto-sigmoid resection method. They also show its innocuous nature, since it was

employed in the case of very old and very sick people. A sutured recto-sigmoid anastomosis is particularly applicable after recto-sigmoid resection for a diverticular tumour.

'*Telescopic*' *Recto-Sigmoid Anastomosis.*—In some cases of recto-sigmoid resection, a sutured anastomosis between the sigmoid and the stump of the rectum cannot be made because of mechanical disabilities. This happens in fat people, in males with narrow pelvis, and in the case of a small or short rectal stump, or where its blood-supply may be in doubt. In such circumstances, the rectal stump may be closed, the peritoneum sutured over it and the divided end of the sigmoid implanted into the abdominal wall. Then, at a later stage, when the peritoneum has become 'glued' on to the rectum, the sigmoid may be disconnected and drawn through an opening in this rectal pouch, the sphincter of which is divided, as shown

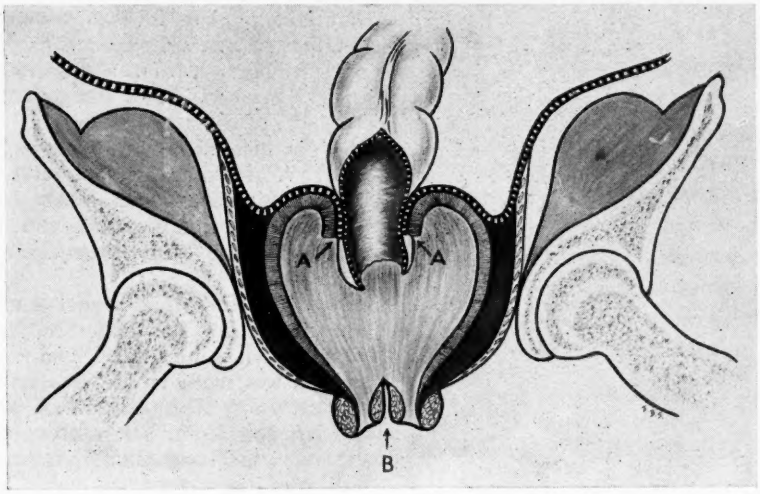


FIG. 267.—Shows diagrammatically the cut end of the sigmoid telescoped into the rectal pouch. A few sutures (A) connect the peritoneum of the sigmoid to the peritoneum covering the rectal pouch, so that, as the sigmoid is drawn down, peritoneal surface becomes applied to peritoneal surface. B shows diagrammatically the division of the sphincter so as to make the anus patulous and prevent any secretion accumulating in the rectal pouch.

in *Fig.* 267. As the sigmoid is functionless and the rectum patulous from the division of the sphincter ani, there is no more danger from this 'telescopic' operation than from drawing the sigmoid on to the surface of the abdominal wall to make an ordinary abdominal artificial anus.

A difficulty, however, in this method is that sometimes it is not easy to make the opening in the rectal pouch, because the bladder falls over and adheres to the rectal stump.

The method is particularly applicable to *bad* cases of carcinoma of the lower end of the sigmoid, for the making of the telescopic anastomosis can be delayed for six months, when the patient will have greatly improved in health as a result of the removal of the malignant growth, and the rectal stump will have become thoroughly vascularized; the anastomosis can then be made with a great degree of safety.

The two following case histories—*Cases* 4 and 5—illustrate the uses of this telescopic method of recto-sigmoid anastomosis:—

Case 4.—A very fat man, aged 56 years, a hotelkeeper, developed acute intestinal obstruction. He was operated on in the country, and what appeared to be an inoperable carcinoma of the sigmoid was found. In order to relieve the obstruction, an artificial anus was made in the upper end of the sigmoid.

Subsequent investigation by me created the suspicion that the tumour was inflammatory, and that it was the result of an extensive diverticulitis.

At a second operation the whole of the sigmoid, including the portion bearing the artificial anus, was removed. It was impossible to approximate the divided end of the bowel in order to make an anastomosis. Consequently it was necessary to close the divided rectum by suturing the muscle layer and the peritoneum separately, and also to implant the distal cut end of the beginning of the sigmoid into the loin, where it would function as an artificial anus.

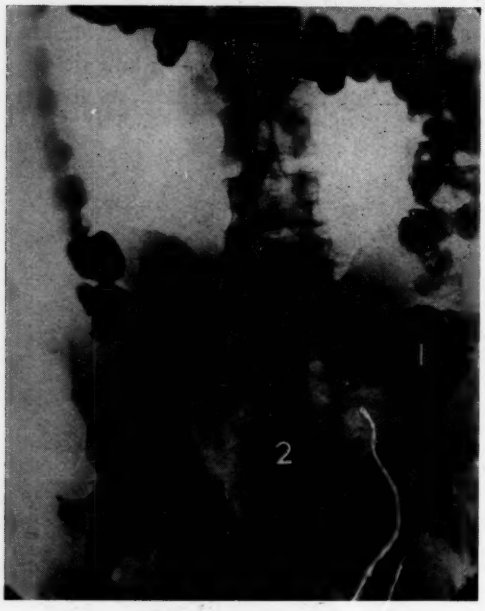


FIG. 268.—*Case* 4. Radiograph of the distal part of the colon and the rectal stump (this was filled from the anal canal). After four years the distal end of the descending colon had elongated a little from the increased function imposed upon it. Note the smallness of the rectal stump. 1, Lower end of descending colon; 2, Stump of rectum. (By courtesy of the *Australian and New Zealand Journal of Surgery*.)

Four years later, at the request of the patient, who could no longer tolerate the artificial anus, I decided to make an attempt to unite the descending colon to the rectum. The radiograph, *Fig.* 268, shows the high level of the division of the sigmoid and the smallness of the rectal stump.

The method employed was as follows:—

1. A disconnecting transverse colic anus was made in the manner already described.

2. The descending colon and the rectum were cleaned, by daily lavage, for a period of three weeks.

3. The following were the steps of the operation: (*a*) The abdomen was opened by a median subumbilical incision; (*b*) An incision was made around the artificial anus in such a way that a substantial ring of skin was left attached to the mucous membrane, the anus was disconnected from the abdominal wall, and the descending colon was extensively mobilized; (*c*) A rubber tube, 2·5 cm. in diameter, cut as shown in *Fig.* 269, was sutured to the ring of skin which, for this purpose, had been left attached to the artificial anus; (*d*) A sponge holder with a swab on its end was now introduced through the anus into the rectum and pressed against its blind upper end; (*e*) An incision, 3·75 cm. long, was made from the abdomen through the rectal wall on to the swab; (*f*) The forceps were now made to grip the end of the tube and draw it through, with the attached bowel, into the rectum. (*Fig.* 269.)

The rectal stump had contracted from disuse, and, as the patient was very fat, a tunnel had therefore to be made posteriorly to the bladder before the rectum could be incised. Consequently, when the bowel was drawn through the tunnel, there was no space whatever which would permit the manipulations required for the insertion of sutures to unite the cut edge of the rectal wall with that of the colon. Union of the bowel ends was then attained as follows: The obliquely-cut part of the tube was drawn down through the anus and kept in this position with gauze and a very large safety-pin inserted as shown in *Fig.* 269 (G). The sphincter, grasping the obliquely-cut part of the tube, prevented the tube from moving downwards; the safety-pin prevented it from going upwards. The bowel ends were therefore held in the position in which they were placed. The slotted part of the tube drained any contents which might have accumulated in the rectal cavity. A drainage tube was introduced abdominally down to the junction of the colon with the rectum.

The convalescence of the patient was uneventful. Four weeks after the operation, when it was found that the anastomosis was firmly healed, a little local anæsthetic was injected into

the small strip of skin between the bowel ends, and the spur of the mid-colic anus was crushed with a long enterotome. The artificial anus then closed naturally in a very short time. Four

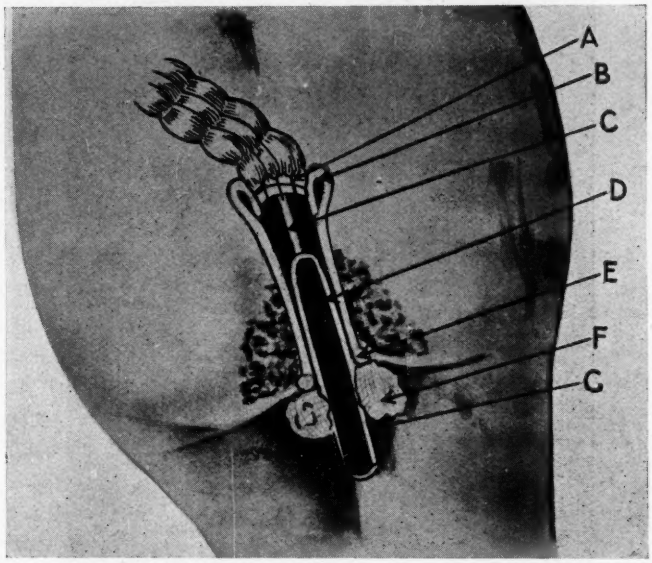


FIG. 269.—*Case* 4. Diagrammatic section of the rectum viewed posteriorly, showing slotted tube attached to the lower end of the cut end of the distal part of the colon drawn through the anal canal and fixed there. A, Ring of skin round artificial anus sutured to rubber tube; B, Invagination of cut end of rectum; C, Rubber tube; D, Sliced part of tube; E, Sphincter grasping slender sliced part of tube and preventing it coming out; F, G, Gauze and safety-pin preventing the tube from going up.
(By courtesy of the *Australian and New Zealand Journal of Surgery*.)

years later, an X-ray (*Fig.* 270) showed that this patient was functioning perfectly, and that no contraction had taken place at the telescopic union.

Case 5.—A female, aged 55, who had a carcinoma of the lower end of the sigmoid, was operated on in the following stages:—

Stage 1: Disconnecting anus made at the proximal part of the transverse colon, when an exploration revealed a carcinoma situated close to the lower end of the sigmoid.

Stage 2 (three weeks later): Resection of the lower end of the sigmoid and the upper part of the rectum; closure of the rectum, implantation of the cut end of the sigmoid into the abdominal wall.

Stage 3 (many months later, when the patient was in good health): The mobilization of the upper part of the sigmoid, and of the descending colon, and the making of a telescopic anastomosis with the rectal pouch, the sphincter ani of which was divided.

This patient is now well, and has functioned normally for sixteen months. *Fig.* 271 shows an X-ray of the rectum made eight months after the operation.

FIG. 270.—*Case* 4. Shows an X-ray picture of the rectum of this patient, made after a barium clysma followed by injection of air. It was taken four years after the 'telescopic' operation. Note the straight tube-like recto-colic segment.

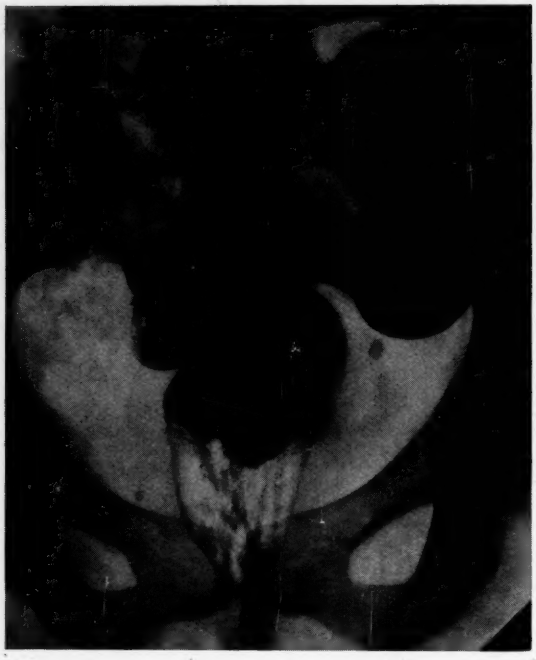


FIG. 271.—*Case* 5. Radiograph of the rectum made eight months after the operation. An X-ray two months after the operation showed an unspillable ink-well type of anastomosis, and she could only tolerate a few ounces of a clysma, none of it passing into the sigmoid. In the X-ray eight months later, this unspillable ink-well type of anastomosis had disappeared, and the patient could take a full enema. It will be noticed in the X-ray that the lower part of the sigmoid has dilated, apparently taking on some of the functions of the rectum.

THE PERINEO-ABDOMINAL METHOD OF RESECTION OF THE RECTUM, RADICAL OR CONSERVATIVE

Having considered conservative methods whereby carcinoma of the lower part of the sigmoid, or of diverticular tumour of the sigmoid may be dealt with, I shall now set out those operative methods which the studies of my rectal work have led me to adopt when dealing with those carcinomatous growths of the rectum which usually require a radical operation, but which, in a small proportion of cases, where conditions are suitable, may be dealt with by a conservative operation; that is, by an operation which preserves the patient's continence.

In these methods, my usual approach to the operation is from the perineum, the recto-sigmoid segment being merely delivered abdominally, so that the mesentery of the sigmoid and the recto-sigmoid segment itself can be studied under vision, and a judgement can be made, according to the spread of the malignancy and the length of the sigmoid, as to whether a conservative operation is possible, or whether a radical operation must be carried out. This operative method can, therefore, be very appropriately called the 'perineo-abdominal approach: radical or conservative'.

The main principles involved in this operation are as follows:—

1. The abdominal spread of the carcinoma is reviewed at a preliminary operation; that is, the operability of the growth from the abdominal side is ascertained.

2. The operation is carried out on a defunctioned and prepared recto-sigmoid.

3. The perineal and the abdominal parts of the operation are carried out simultaneously by the co-operation of the surgeon and the assistant surgeon.

4. The dissection of the rectum is begun, and practically completed, from the perineum, the mobilized recto-sigmoid segment being delivered abdominally.

5. The rectum is isolated, without interfering with its superior hæmorrhoidal blood-supply, and the recto-sigmoid segment is delivered on to the abdominal wall with its blood-supply intact.

6. If the conditions are such that a conservative operation cannot be carried out, the whole of the sigmoid and its mesentery are removed with the rectum—that is, the operation is made a very radical one.

7. If the conditions are such that a conservative operation can be carried out, the ligation of the inferior mesenteric artery is made abdominally, where it can be carried out with accuracy and without injury of the anastomotic points.

The procedure of this radical or conservative perineo-abdominal operation is as follows:—

Preliminary Exploratory and Defunctioning Operation.—At a preliminary operation the abdomen is explored, and the distal colon defunctioned and, for a period of three weeks, prepared in the manner already described.

Position of the Patient.—It is most difficult to devise for the patient a position on the operating table, which will enable a perineal and an abdominal dissection to be carried out at the same time. I have tried the position which has been advocated by Kirschner for this purpose, but I find that it is an impracticable one—anyway, as far as I am concerned.

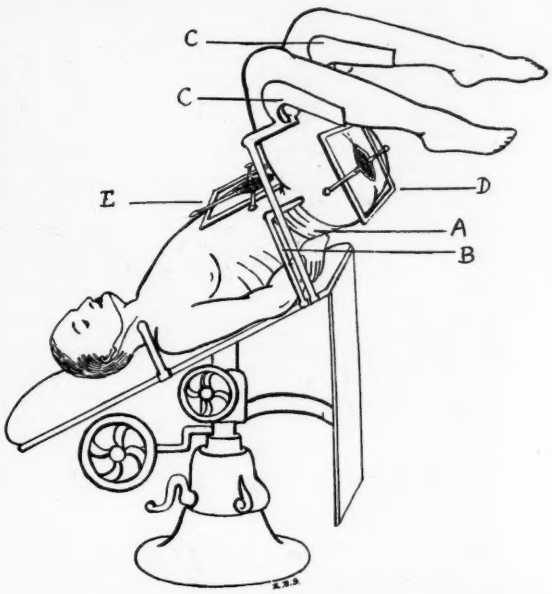


FIG. 272.—Showing the position of the table which is employed to permit the carrying out of the perineal and abdominal part of the perineo-abdominal operation simultaneously. A, Canvas sling which elevates the buttocks about four inches above the end of the table, and thus allows an approach to the coccyx; B, Supports screwed to the table which support this sling; C, Leg rests which are adjustable in all directions. The patient's thighs are semi-flexed on the body and his legs semi-flexed on the thighs and separated widely from one another. The Devine operation frames, D and E, are set in the perineal wound and the abdominal wound respectively. The patient is placed in the Trendelenburg position, and the table is capable of being elevated to the required height.

The position which I employ, in order to permit of the abdominal and perineal dissection going on simultaneously, is as follows: By means of adjustable leg-rests, the patient is placed in an exaggerated lithotomy position, with the thighs spread out and only partly flexed on the abdomen. In order to obtain free access to the coccygeal region—the first objective—the patient's buttocks are raised about four or five inches from the table, by placing them on a canvas sling (*Fig.* 272). In order comfortably to dissect the anterior wall of the rectum—the second objective—the table is tilted till the anus is nearly facing the roof and raised until it lies at a comfortable working level.

The situation of the table is then arranged so that the lower part of the abdomen (the patient is in the Trendelenburg position) is exposed to the artificial light of the operating room, and the perineum to the daylight from the window.

The Steps of the Operation.—

1. The legs, including the rests, and the abdomen are draped so as to give access to the lower part of the abdomen and to the perineum.

2. The surgeon begins work on the perineum, and the assistant surgeon on the abdomen, simultaneously.

3. The surgeon (*a*) makes a perineal incision in the midline posteriorly over the lower part of the sacrum and coccyx, and extending round the posterior half

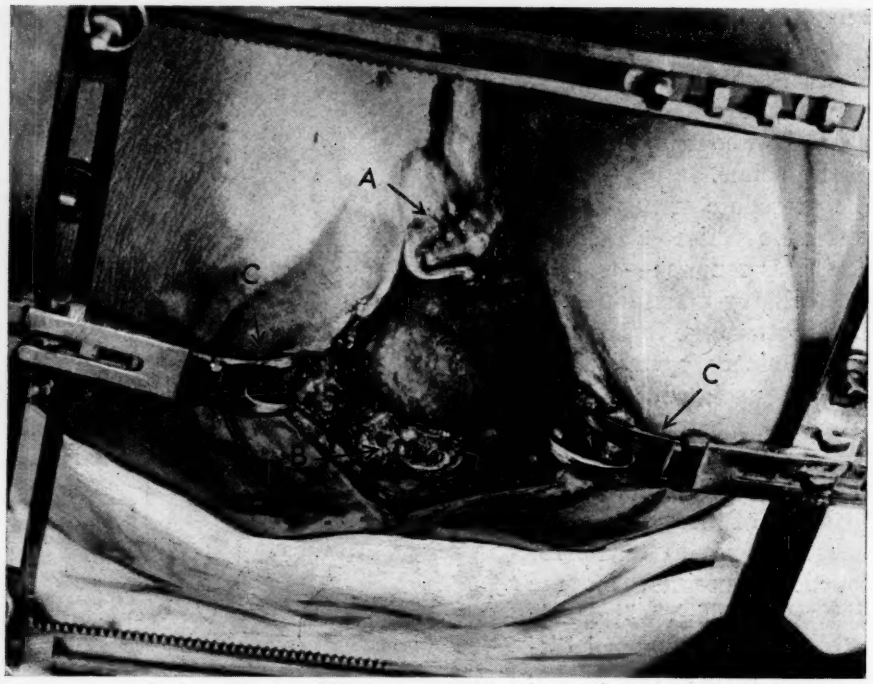


FIG. 273.—Photograph after the insertion of the retractor frame, showing the cavity around the posterior wall of the rectum exposed for dissection. A, Anus; B, End of the sacrum; C, Deep blades of the retractor specially made so as to secure a grip on the lateral walls of the sacral cavity.

of the circumference of the anus; (*b*) removes the coccyx; (*c*) exposes and isolates the posterior wall of the rectum; (*d*) inserts the self-retaining operating frame, and with it, ratchets open the wound—this frame retraction gives an excellent exposure of the rectum. (*Fig.* 273.)

In the case where the anal canal must be sacrificed (a radical operation).—

4. The next step depends on the position of the growth. If the growth be so situated that it is thought the anal canal and the tissues surrounding it should be sacrificed, the dissection should be continued in the following way:—

a. The posterior semicircular anal incision of the skin is now continued around the anus.

b. The anal canal, with the sphincter and fat of the ischiorectal fossæ, is isolated.

c. The cuff of skin thus obtained (it should be a wide one) is turned over the anus, sutured and occluded with a box-clamp, which is closed under great pressure with a key, and connected with a diathermy current in order to sterilize its contents.

The surgeon is now in a position to proceed with the dissection of the anterior wall of the rectum.

In a case where the anal canal can be spared (*a possible conservative operation*).—

5. Should the growth be situated high in the rectum, and should there be little danger of it involving the tissue around the anal canal, the operation may be modified so as to retain this structure for the purpose of preserving, if possible, the continence of the patient. In such circumstances, the surgeon will omit the

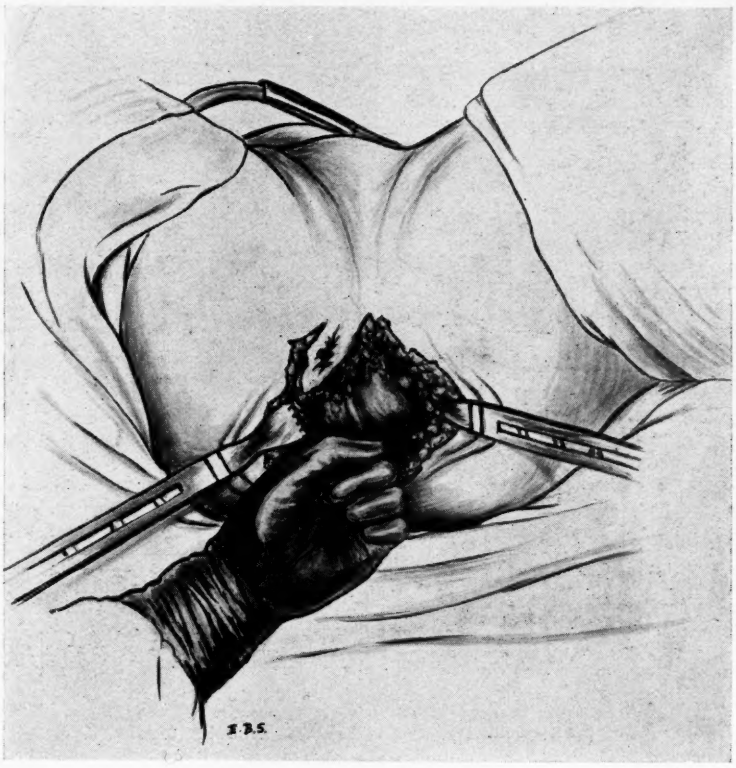


FIG. 274.—Drawing from a photograph showing the isolation of the ano-rectal junction, by running the finger round it.

fourth step, and will seek the junction between the anal canal and the rectum; he will isolate this junction, on its anterior aspect, by a few strokes of the dissecting scissors and by means of his gloved finger (*Fig.* 274). The plane of the anterior rectal wall is easily separated at this point, for it is composed of loose tissue. To this recto-anal junction, the surgeon will now apply the box-clamp, closing it securely on the bowel by means of the key.

6. He cleans the lower end of the anal canal, swabs it out with tincture of iodine, divides the rectum hard on to the lower margin of the box-clamp by means of the diathermy knife, and connects the box-clamp with the coagulating diathermy current.

7. He turns the anal canal forward, as it were, on a hinge, where it is held by a retractor (A) on the frame (*Fig.* 275); he then draws the box-clamp downwards, so as to expose the plane of the anterior wall of the rectum, and follows this plane, which is rather loose, till he reaches the region of the prostate.

8. *The Assistant Surgeon.*—Meanwhile, the assistant surgeon has opened the abdomen, inserted the Devine operating frame, exposed the pelvic cavity, removed small intestines from it, and, by means of the ' mechanical hands ' of the frame, incarcerated these intestines in the abdominal cavity (*Fig.* 276). The assistant now

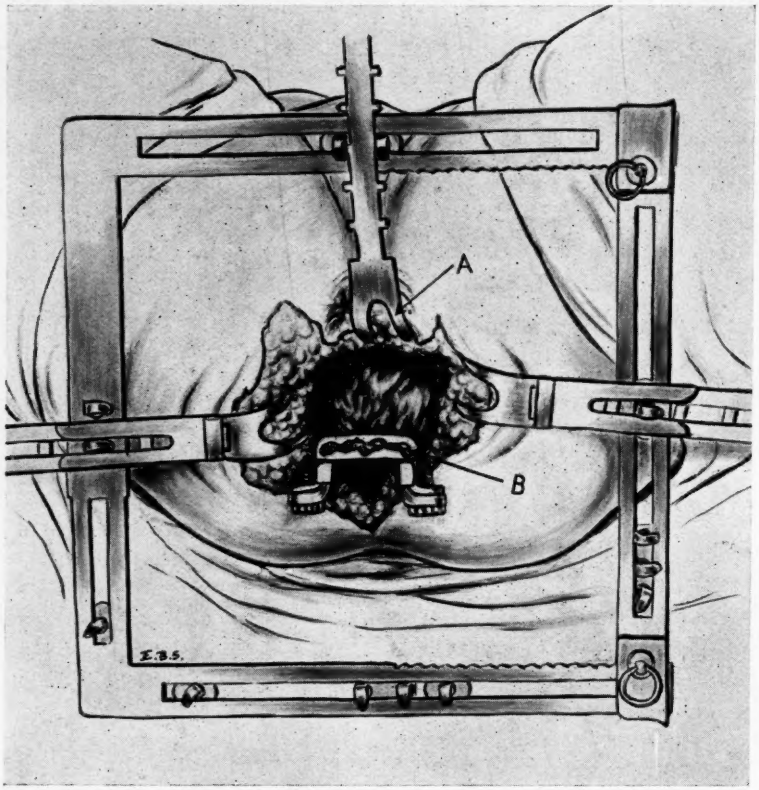


FIG. 275.—Drawing from a photograph showing the rectum divided. A, Retractor drawing the anal canal forward; B, Box-clamp drawn down to expose the anterior wall of the rectum.

pushes downwards from the abdomen the peritoneal reflection between the bladder and the rectum. Helped by this manœuvre, the surgeon (working at the perineum) at once recognizes the proper spot to open the peritoneum and severs it as far as possible from the rectum (*Fig.* 277). He then hands to the assistant surgeon, through the opening in the peritoneum at the vesico-rectal or utero-rectal junction, the box-clamped rectal cut end.

9. The surgeon now puts on fresh gloves and gown and changes over to the abdominal side, and the assistant to the perineal side of the operation. The surgeon draws the box-clamped end of the rectum very slowly, but with gentle tension, out of the pelvis; and, as he does so, rectum, superior hæmorrhoidal artery, and

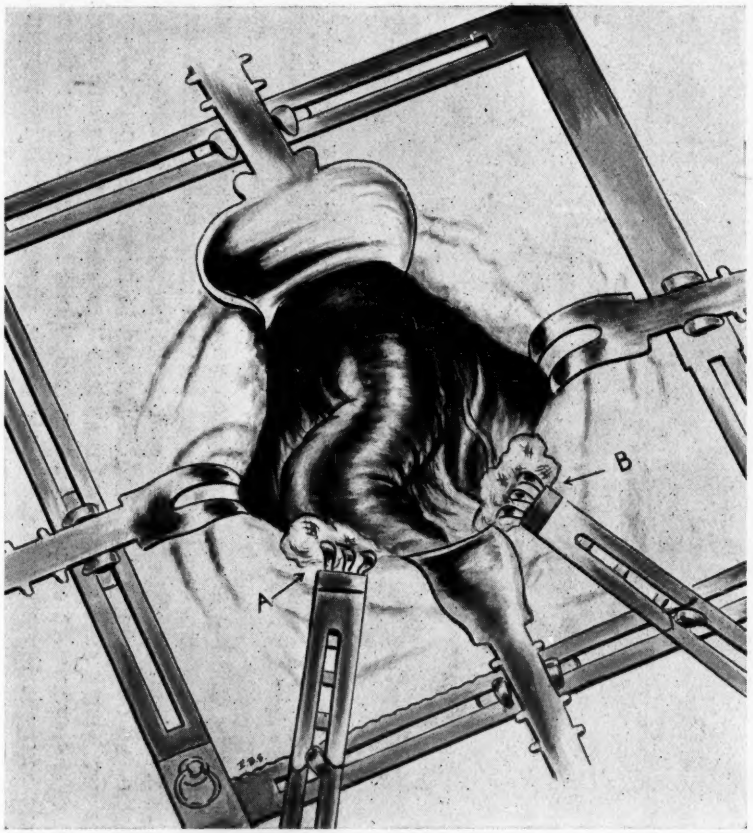


FIG. 276.—Sigmoid exposed by author's operating frame. A, B, ' mechanical hands ', with gauze scarves, used to keep small intestines out of operation field.

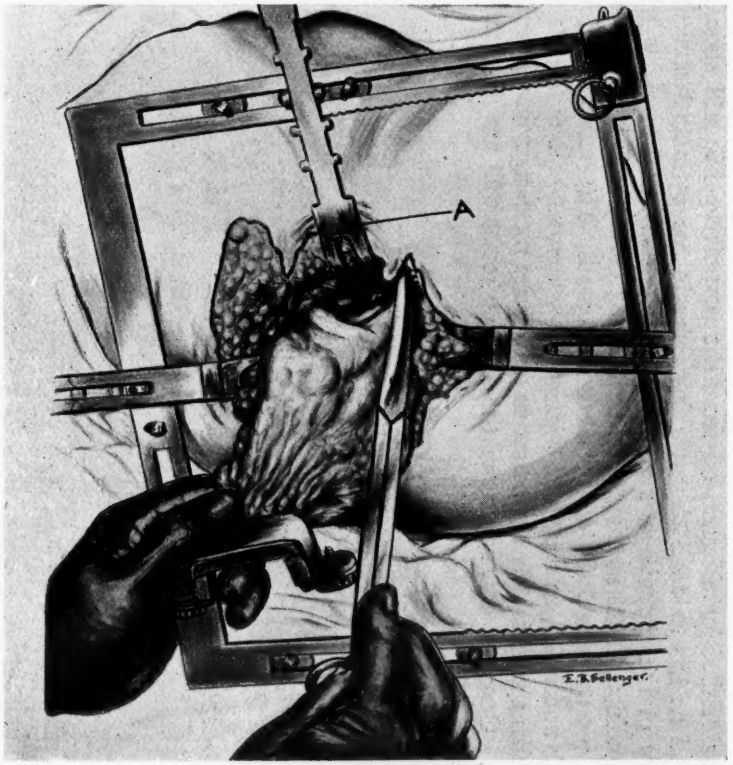


FIG. 277.—Drawing from photograph of the peritoneum being opened from the perineum by the surgeon, at the terminal point of the anterior wall of the rectum. Note how the ' mechanical hands ' (A), pulling the anal canal forwards and upwards, expose the anterior wall of the rectum.

mesentery of the sigmoid strip off from the posterior pelvic and abdominal wall; indeed, all he has to do is to put a few snips in the peritoneal reflections of the mesentery of the sigmoid as they are put on tension, and in a few minutes the recto-sigmoid segment as far as the descending colon, with its mesentery and its vascular supply intact, lies on the abdominal wall. The vessels are for the time being left undivided, as shown in *Fig.* 278.

It takes a surprisingly short time to deliver the recto-sigmoid on to the abdominal wall. Once the connections of the anterior rectal wall are dissected—and this

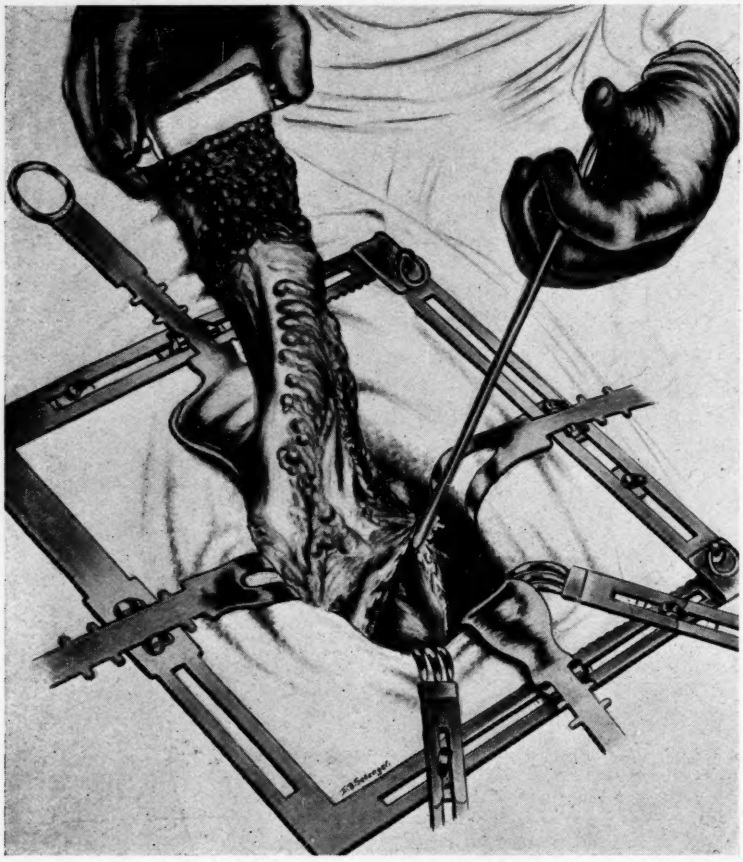


FIG. 278.—Drawing from a photograph, showing the inferior mesenteric artery divided below the origin of the first sigmoid artery. This division allows still further the elongation of the recto-colic segment, so that, in this case, when the rectum and sigmoid were brought down to the anal canal, a segment adequate for the removal of the disease could be excised.

takes only a short while—the whole of the rectum and the sigmoid can be ' stripped ' off the posterior abdominal wall and up to its vascular pedicle, in much the same way as, after the cutting of the peritoneum on its lateral side, the right or left part of the colon can be ' stripped ' to the midline and to its vascular pedicle.

If it has been found necessary to remove the anal canal, there can be no question of a conservative operation, and a radical one is carried out: the inferior mesenteric artery is ligated, and the whole of the sigmoid, with its mesentery, is

amputated, its divided end being implanted into the anterior abdominal wall. The transverse colic anus continues to function, and in many instances is more controllable than a sigmoid anus. Should, however, the transverse colic anus give any trouble, it can easily be closed, when the sigmoid anus will function.

If, however, the anal canal has not been removed, the question now arises whether a radical or a conservative operation should be carried out.

The Question of a Radical or a Conservative Operation.—The surgeon carefully examines the extent of the disease: he examines the growth in the rectal wall itself to see if it has penetrated through the muscular coat; he examines any glandular metastases in the mesentery, and their extent. If the growth be one of those 'invasive' types of carcinoma of the rectum in which the metastatic spread in the mesentery of the sigmoid is definite, no conservative operation should be attempted, but the rectum, with the sigmoid and its mesentery, should be removed in the manner described.

If, on the other hand, the local lesion is not very invasive; is not extensive, or has not penetrated the muscular walls; if no metastatic glandular spread is obvious; if there are possibly only a few paracolic glands in the lower part of the mesentery, and these, as is often the case, are of doubtful malignancy, the surgeon will consider the question of carrying out a conservative operation. He will examine the sigmoid to see if it will be long enough, when it is straightened by division of its mesentery and of its vessels at the correct places, to be passed through the anal canal and to extend a little beyond its lower margin; that is, long enough to preserve continence for the patient.

If the malignant condition be such that a conservative operation can be carried out, and if the sigmoid is long enough to reach the anus, as it was in the case here illustrated, the next step is to provide for a circulation to that part of the sigmoid —probably the middle—which is to form the anal canal. In this particular case the sigmoid was big and the first sigmoid artery was very long, consequently the inferior mesenteric artery was divided below the first sigmoid artery. This long sigmoid artery reached to the anal canal, so that part of the sigmoid which was to form the new anal canal would be supplied directly by the first sigmoid artery.

If the arterial supply of the new anal canal can be satisfactorily provided for, the box-clamped end of the bowel is passed back through the pelvis to the perineal wound, where the assistant surgeon grasps it and draws it through the anal canal, the sphincter of which is divided; with a few sutures, he adjusts it in position (*Fig.* 279), and amputates most of the recto-sigmoid segment, leaving only a short piece protruding beyond the anal canal. It is advisable to remove some of the mucous membrane from the upper part of the anal canal, so as to facilitate the union of the sigmoid segment with the canal.

It should be remembered that the opportunity to perform a conservative operation does not arise very often, and also that it requires a good deal of surgical experience to be able to recognize the less malignant type of rectal carcinoma which is amenable to this treatment.

In the conservative operation which I have just described, the patient recovered from the operation with very little shock. The bowel loop beyond the anal canal lived, and the patient's general condition was quite good. However, he died suddenly, some days after his operation, from what appeared to be a coronary embolus. This case showed the viability of the bowel placed in the anal canal,

nourished by a direct blood-supply from the first sigmoid artery. Taken in conjunction with the encouraging results of many other conservative operations which I have carried out by a less advantageous perineal method (discussed later), the experience obtained from this conservative operation, carried out with improved technique, is not without value.

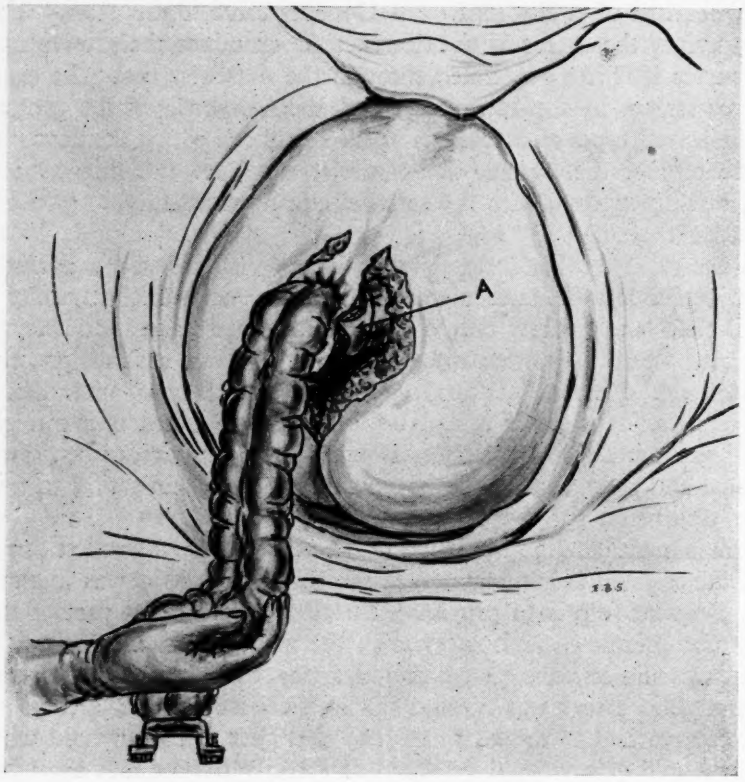


FIG. 279.—Shows the straightened sigmoid and rectum passed back to the perineum and through the anal canal, the sphincter of which has been divided. A few sutures connect the upper edges of the anal canal with the sigmoid, so that, when it is drawn down, the sigmoid is invaginated into the canal. A shows the anal canal.

Gangrene of the Rectal Stump.—Gangrene of the sigmoid stump may occur in conservative operations carried out on a defunctioned distal colon and rectum. In this case, a few stitches are taken out of the perineal wound, and the gangrenous segment is promptly removed. As the bowel is defunctioned, the danger of sepsis from leakage of septic bowel contents does not arise as a result of the gangrene, as it would if the conservative operation were done on a functioning bowel; the perineal wound heals, after the removal of the gangrenous segment, much in the same way as it does in a Lockhart-Mummery's operation for carcinoma of the rectum. The abdominal anus now becomes a permanency, and serves just as well as an inguinal anus, or even better; and the patient, therefore, is practically no worse off because a conservative operation has been attempted.

The Conservative Operation: the Question of the Vascularization of that part of the Sigmoid which is to form the new Anal Canal.—Of all requirements for a successful

conservative operation, the most difficult one to fulfil is the provision of an adequate circulation for that part of the sigmoid which is to form the new anal canal. Since, in the perineo-abdominal operation, the circulation can be adjusted abdominally and therefore precisely, there are alternative methods. If the sigmoid arteries be short and for this reason it be necessary to rely on a collateral circulation, the division of the inferior mesenteric artery may have to be made at different levels according to the manner in which the sigmoid arteries arise from the superior mesenteric. Where they arise in a bunch, or where the first sigmoid comes off the left colic (as it does in eleven out of twenty cases, according to Hamilton Drummond[3]), the ligature will have to be placed below the left colic. The collateral circulation will then depend on the richness of the anastomosis between the left colic and the first sigmoid, or on that from the first sigmoid loop, when this arises from the left colic. On the other hand, the sigmoid arteries may arise separately from the inferior mesenteric. In this case, the ligature will be applied between the first sigmoid and the left colic. In all these cases, the collateral circulation will come from either the left colic or the first sigmoid branch, and thence through the other sigmoid branches; the return circulation, through the butt of the inferior mesenteric, will be of very little value, for this vessel with the superior hæmorrhoidal must be sacrificed.

Where the sigmoid arteries are long, the first or middle sigmoid artery with its branches may be long enough to reach the anus. In one case in which I performed a conservative operation, it was possible to have that part of the sigmoid, which was to form the new anal canal, directly vascularized by the first sigmoid artery. Thus, in certain cases where the segment is long, it is not necessary to rely on a collateral circulation; a direct circulation may be obtained, the adequacy of which can be tested before the part is placed in the anal canal.

Personally, I have always been afraid to rely very much on a collateral circulation. However, in regard to this collateral circulation, I have recently made several operative observations which have given me more confidence in its adequacy. I have learnt from these observations how a collateral circulation will behave in the live body, and I have therefore more confidence in its efficiency than I had previously. This factor, taken in conjunction with the knowledge that, as I now operate on a defunctioned distal colon and rectum, I am in a position to retreat if gangrene of the rectal stump occurs, makes me feel that I shall, in the future, take more advantage of this collateral circulation in order to carry out a conservative operation which, in its radical quality, may be almost equivalent to that of the standard radical operation.

With regard to this collateral circulation, my conclusions are based on the following observations, made on living patients, and, for this reason, of considerable value. In the case of a woman, after making an abdominal incision I tied and divided the inferior mesenteric artery distal to the left colic, leaving the sigmoid and rectum in position. Three weeks later, I mobilized the sigmoid and rectum from the perineum, with a view to their removal, and found them both highly vascularized: an adequate rectal and lower sigmoid circulation had taken place following the division of the inferior mesenteric artery, probably because the lapse of time had 'determined' an adequate circulation much in the same way as, given sufficient time, an adequate circulation can be 'determined' in a tube pedicle skin graft.

In the case of three other patients, I operated from the perineum; I mobilized the rectum and lower part of the sigmoid, isolating the recto-sigmoid segment with its mesentery, and with its superior hæmorrhoidal blood-supply intact, and then delivered the whole segment through the abdominal incision on to the anterior abdominal wall. Instead of amputating this recto-sigmoid segment to make a radical operation, I allowed it to remain on the abdominal wall in dressings; but I divided the inferior mesenteric distal to the origin of the left colic in one case, and distal to the origin of the first sigmoid in the others.

Thus, this recto-sigmoid segment could only be vascularized through a collateral circulation—through the left colic to the first and second sigmoid arteries, and to the butt of the inferior mesenteric and to the branches of the superior hæmorrhoidal artery. In each case, these isolated recto-sigmoid segments, the longest one measuring twenty-two inches, were allowed to lie in dressings for a week, on the abdominal wall.

In one case the segment lived even to the lower end, which is the junction of the rectum with the anal canal, and was perfectly vascularized. It had shrunk very much longitudinally. This one case shows that, in the live body, the anastomotic points between the circulation of the rectum and that of the sigmoid, and between the branches of the superior mesenteric and those of the hæmorrhoidal artery, can function perfectly. It does not, of course, prove that this would take place in every case. In the other two cases in which the inferior mesenteric was tied, the vascularization of the isolated segment was not as complete as in this case; the last one and a half inches of the rectum became gangrenous.

As, in conservative rectal operations, it would be necessary for only a very limited extent of the sigmoid to be dependent on a collateral circulation, the above observations, in which the whole of the rectum was nourished by a collateral circulation, make me confident that, by careful 'determination', I shall be able to establish sufficient collateral circulation to the sigmoid in cases where the conditions permit the performance of the improved conservative operation.

THE RELATIVE MERITS OF THE RADICAL AND THE CONSERVATIVE METHODS OF RESECTION OF CARCINOMA OF THE RECTUM

In view of the fact that there is a greater possibility of success in carrying out the conservative operations which I have here described, than in employing any of the methods at present in vogue, it may perhaps be of value to discuss results of less effective conservative methods which I have practised in the past, and also to consider those of other surgeons.

A Conservative Extended Perineal Operation.—In the early years of my rectal surgery (from 1913 onwards), I employed for rectal carcinoma a conservative operative method, for the knowledge of which I was indebted to Professor Watson (then Professor of Anatomy in the Adelaide University). In this operation, working from the perineum, and sparing the sphincter and the levator ani, I isolated the rectum, divided the peritoneum as it was reflected from the

recto-sigmoid junction, divided the superior hæmorrhoidal artery, and, by dividing the lowest sigmoid artery, partly mobilized the sigmoid and its mesentery. The middle of the sigmoid was sutured into the muscles of the denuded sphincter and of the levator ani (*Fig.* 280). It was an operation somewhat similar to the operation of *abaissement* of the rectum which was performed by French surgeons. In a male this extended perineal operation was difficult, but in a female it was often an easy operation. It was certainly a practicable one, for I successfully carried it out many times. That part of the sigmoid which was placed in the sphincter ani depended on the first or second sigmoid artery for its nourishment. This, however, was one of the weak points of the method, for gangrene of the stump occasionally occurred, the delicate sigmoid artery encased in friable mesentery being often injured—as it easily could be—when the sigmoid mesentery was being dissected and brought down in the confined space of a narrow pelvis. In favourable circumstances (especially in women) I was surprised to see how much of the sigmoid and its mesentery I was able to remove.

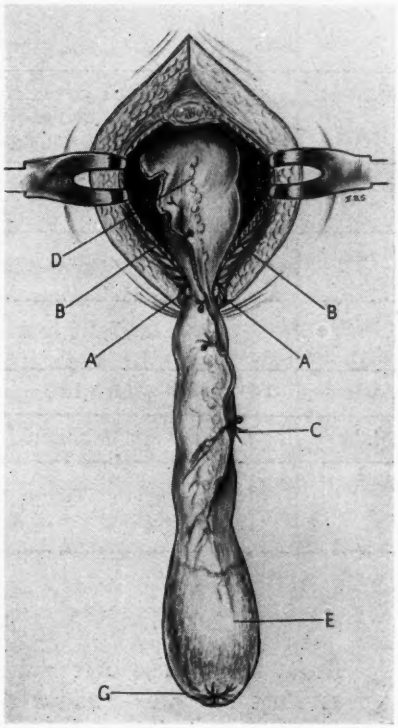


FIG. 280.—Drawing of the operation of *abaissement* of the rectum, just as it is nearly finished. A, Denuded sphincter ani, which is divided on its posterior surface; B, Divided levator ani; C, Cut superior hæmorrhoidal artery; D, Sigmoid and the mesentery which has been brought down, and which is lying now in the denuded anal sphincter; E, Ampulla of the rectum; G, Anal canal, shown here closed with a purse-string suture.

In eight out of twelve of these operations, I was able to preserve the patient's continence. The operative mortality-rate was low. The interesting observation, however, which emerges from a study of this group of cases, is that six patients, on whom a conservative operation had been done, that is 50 per cent, lived for many years (5, 10, 12, 15, and 18 years) and that 50 per cent died after the operation or in a year or two. The table on p. 380 shows the detailed results of this series of conservative rectal operations.

Any possibility of ultimate success in conservative or in perineal operations is, of course, based on the pathological fact that, in a considerable number of cases, carcinoma of the rectum remains local. In a painstaking investigation, covering a large amount of material (specimens of carcinoma of the rectum obtained from operation clinics), Westhues[6] found that only 55 per cent of cases of carcinoma of the rectum showed involvement of the neighbouring lymphatic glands or of the pelvic connective tissue.

Once carcinomatous metastasis has spread to the glands of the mesentery of the sigmoid, it is doubtful whether the radical operation completely removes this mesenteric spread; and, indeed, whether, in some of these cases, it benefits the patient any more than by removing the local growth and thus giving him a temporary respite.

RECTAL CARCINOMA: RESULTS OF TWELVE OPERATIONS BY AN EXTENDED PERINEAL METHOD

SEX	AGE	STAGE OF DISEASE	CONTINENCE	DURATION OF LIFE AFTER OPERATION
Female	49		+	5 years. Local recurrence
Male	55		+	12 years
Female	42	Had been considered inoperable	+	15 years
Female	60		+	10 years
Female	45		—	18 years. Has syphilis as well as carcinoma of the rectum. Gangrene of stump occurred. Second operation, abdominal anus
Female	50	Had been considered inoperable	+ (?)	12 years. Continent anus, then stricture occurred. Second operation to make abdominal anus
Male	50	Very late	+	2 years. Fixation to prostate and bladder. Died of local recurrence
Female			+	1 year. Local recurrence. Had abdominal anus made
Male	55	Late	+	2 years. Later developed urinary fistula
Male	66	Very late	—	5 days
Male	77	Very debilitated	—	6 days. Pneumonia
Male	48	Late	—	5 weeks. Cystitis. Low sepsis in pelvis. Good deal of cancer toxæmia beforehand

CONCLUSIONS

From my studies of rectal surgery, I draw the following conclusions:—

1. That the pre-operative defunctioning and preparation of the rectum and sigmoid make possible rectal operations which had previously been regarded as impossible; for example, a recto-sigmoid anastomosis becomes a reasonably safe operation.

2. That, by the use of a special operative position (exaggerated lithotomy, with a sacral sling), synchronized perineal and abdominal operating can take place—a method which considerably shortens the time for the radical resection of the rectum, and, therefore, lessens shock.

3. That operation in the position advocated above, and operation on the defunctioned rectum closed at its lower end by a special box-clamp, enable a dissection of the rectum to be safely carried out from the perineum towards the abdomen, the dissected segment with all its vessels intact being only abdominally delivered; and that such a method of dissection of the rectum has many advantages.

4. That the method of dissection of the rectum from the perineum to the abdomen—the perineo-abdominal method—can be advocated, for it has the following advantages :—

a. It makes resection of the rectum a comparatively easy operation, the only dissection required being that of the plane between the anterior wall of the rectum and the bladder, after which dissection the rectum and sigmoid can be 'stripped' up from its tissue planes into the abdominal wound.

b. The method considerably lessens the time of the operation.

c. The dissection, being almost entirely perineal, lessens shock to a considerable degree.

d. The method enables inoperability to be discovered early in the operation, before any vessels are divided, and when retreat is possible.

e. It facilitates the simultaneous carrying out of the perineal and the abdominal parts of the operation.

f. It enables the surgeon, at the end of the operation, when the whole of the diseased area is spread out before him and before the vessels are divided, to judge, (i) from the point of view of the extent of the disease, (ii) from the point of view of the length of the sigmoid colon, whether a conservative operation can be carried out; while, as a corollary to this advantage, it permits the more frequent performance of the conservative operation, and, furthermore, permits its performance on a sound basis.

g. It also enables the surgeon to be somewhat more radical in the removal of the sigmoid and its mesentery than in the abdomino-perineal operation; for at times, in this latter operation, not enough of a dilated sigmoid can be incarcerated under the sutured pelvic peritoneum to enable the whole of the mesenteric leaf of the sigmoid to be removed in extensive metastases of this structure.

5. That the experience and knowledge obtained from the observations that I have made on the recto-sigmoid collateral circulation in the living subject; the favourable results, both immediate and remote, obtained in my early conservative surgery of the rectum; the simpler, more expeditious, and sounder method of operating on the rectum advocated in this paper—all, taken in conjunction, make me feel that in future I may be able not only to select pathologically many more cases favourable for the conservative operation, but also to attain more consistent success in carrying out these conservative operations, where they are pathologically and anatomically applicable.

6. That, from these studies, there arises no suggestion of a plea for the conservative operation, but only the feeling that it is greater surgical art to utilize our pathological knowledge of carcinoma of the rectum in employing the conservative operation more frequently than has hitherto been the case, in doing it with discretion, and, when we do employ it, in using every artifice of our surgical art to make it more consistently successful.

REFERENCES

[1] DEVINE, H. B., *Brit. Med. Jour.*, 1935, ii, 1245.
[2] DEVINE, H. B., *Med. Press and Circular*, 1935, cxc, No. 5022.
[3] DRUMMOND, HAMILTON, *Brit. Jour. Surg.*, 1914, i, 677.
[4] MILES, W. ERNEST, "Rectum and Anus", *Post-graduate Surgery* (Ed. R. Maingot), 1936, vol. i, pt. iii, 1408. London: Medical Publications Ltd.
[5] MILES, W. ERNEST, *Ibid.*, 1472.
[6] WESTHUES, H., *Arch. f. klin. Chir.*, 1930, clxi, 582.

SARCOMA OF THE BLADDER

By GEORGE Y. FEGGETTER, London

Sarcoma is very rare in comparison with other growths of the bladder, and the recorded number of cases is still very small. Munwes in 1910 collected 107 cases; in 1929 the number had been increased to 128 (McCarthy); and since then other isolated cases have been reported. I have been unable to trace any case treated by resection in Britain. In 1932 Gabe, who reviewed the literature at that time, recorded a patient, aged 54 years, suffering from a 'sarcocarcinoma' of the bladder which was treated by implantation of radium and who died on the following day.

The rarity of the condition was clearly demonstrated in an investigation by Gardner in 1915, who found that in 1702 operations for bladder growths in 369 patients only 7 were for sarcoma. Geraghty found 2 sarcomas in 180 bladder neoplasms; Fuchs found 1 in 136 cases; and Caulk had only 1 in 303 tumours.

The low incidence rate of the disease limits the urologist's individual experience at most to a few cases, yet a careful study of the available literature enables one to give a general description of this condition.

CASE REPORT

A girl (*Case No.* 8646), aged 10 years, was admitted to the Medical Department of Hammersmith Hospital on Oct. 1, 1936, with painless hæmaturia of one day's duration. Her father was phthisical, and for two years the child had been under observation at the Tuberculosis Dispensary, and was attending an open-air school, where, though of delicate constitution, she was making satisfactory progress.

There was nothing of special interest in the previous history, and she had never experienced any symptoms of urinary disease until the attack of hæmaturia which brought her to hospital.

On Examination.—The following are the relevant features:—

The child was well developed and well nourished. She had a pale, pasty facial appearance and rather puffy eyelids. The cardiovascular system was normal. Blood-pressure 106/76. No enlargement of spleen. The kidneys were not enlarged. No evidence of vulval hæmorrhage.

Urine.—Bright-red due to profuse hæmaturia; no casts; no pus cells; albumin, 50 mg. per 100 c.c.; no organisms; sterile to culture; special examination for T.B. negative on several occasions.

Blood Examination.—Erythrocytes 5,000,000; hæmoglobin 90 per cent; colour index 0·9; leucocytes 11,000 (polymorphs 64 per cent, lymphocytes 36 per cent); platelets plentiful in stained films; blood urea 40 mg. per 100 c.c. blood.

Progress.—The child continued to pass blood in the urine, and although the quantity varied, it was never absent.

Tests to exclude general blood diseases were made. Bleeding time 2 minutes; coagulation time (Lee and White) 11 minutes; red-cell fragility normal; blood platelets 400,000 per c.mm.; Wassermann and Kahn tests negative; plain X-ray of kidneys, ureters, and bladder showed renal outlines normal and no opaque urinary calculus.

As the result of the continued blood-loss the blood hæmoglobin steadily fell. One week after admission blood hæmoglobin was 74 per cent; 11 days after admission blood hæmoglobin was 44 per cent and erythrocytes 2,300,000; 12 days after admission blood hæmoglobin was 34 per cent.

At this time the general condition of the child had deteriorated so much that she was given a transfusion of 400 c.c. of blood.

During the transfusion the opportunity was taken of taking intravenous pyelograms by adding uroselectan B to the blood. These pyelograms showed normal kidney pelves.

On the following day a cystoscopic examination was made, and because of her poor general condition this was done without anæsthetic, the little girl co-operating fairly well.

CYSTOSCOPY.—The bladder contained bloody urine. The capacity was normal. No evidence of cystitis was seen. Some blood-clot was still present in the bladder base. The left ureteric orifice was normal and a clear efflux was seen. The right ureteric orifice was normal, and above it, in the fundus of the bladder, was a mass about 2 × 2 cm. in extent. It was dome-shaped, with a finely lobulated surface, and had the appearance of a tumour covered with bullous œdema. There was much clot below it but no active bleeding could be seen. It was diagnosed as a tumour of the bladder of indeterminate nature.

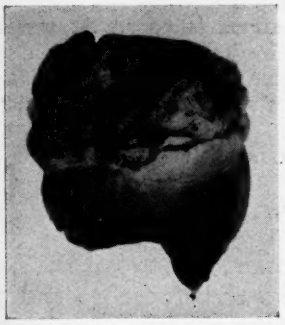


FIG. 281.—Sarcoma of the bladder after removal with surrounding bladder wall. (*Natural size.*)

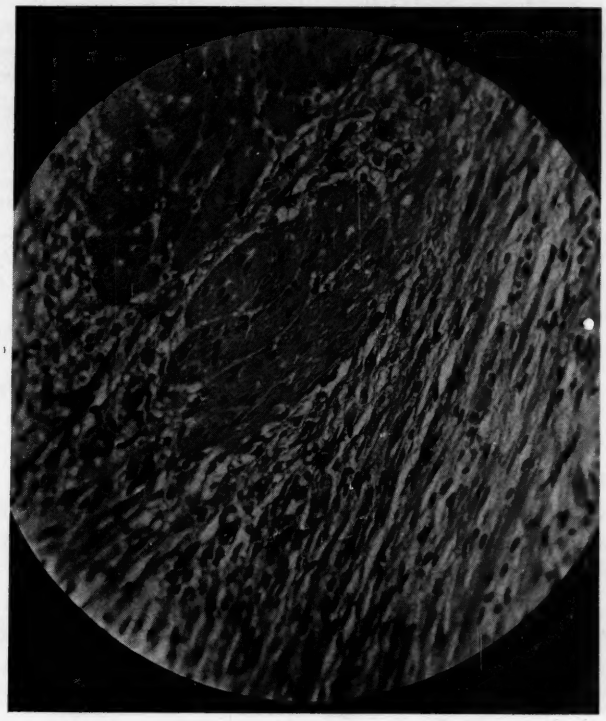


FIG. 282.—Microscopic section of the tumour.

On the following morning the child was anæsthetized, cystoscopy was repeated, and a clear view of the tumour was obtained. It was clearly demonstrated that across the dome of the tumour was a linear fissure from which there was considerable bleeding. As the general condition of the patient was not good an attempt was made to control the bleeding with coagulating current, but this was ineffectual, so it was decided to resect the tumour.

OPERATION.—A midline suprapubic incision was made. The peritoneum was stripped up from the anterior and superior surface of the bladder, and a hard rounded tumour could be felt to the right of the midline on the superior surface. The peritoneum could be separated from the surface of the tumour, which was now seen to be infiltrating the bladder wall.

The bladder was opened below the tumour, which was then excised with half an inch of apparently healthy bladder wall all around it. The bladder was sutured around a tube and the wound closed in layers.

PATHOLOGY.—The specimen (*Fig.* 281) showed a rounded tumour of firm consistance projecting well into the lumen of the bladder. The base was infiltrating the bladder wall. It was about 2 cm. in depth, and across its fundus was a linear fissure. Macroscopically it appeared sarcomatous.

The pathologist reported on its microscopical characters (*Fig.* 282) as follows :—

Spindle-celled Sarcoma.—The growth in the portion sectioned is in the outer part of the bladder wall, pushing the muscular and mucosal coats inwards towards the lumen, and invading the muscle. It consists of elongated cells, the cytoplasm extending as a broad process beyond the nucleus at either end, and sometimes anastomosing with neighbouring cells. The cytoplasm is often finely vacuolated. In parts, there is a considerable amount of myxomatous material, which takes mucin stains, between the individual tumour cells.

Attempts to demonstrate striped muscle striation in the tumour cells have failed.

While it is always risky to name the exact tissue of origin of a sarcoma, the structure and position of this growth suggests that it may well have arisen from unstriped muscle.

PROGRESS.—The child made an uneventful recovery, and was up and about with the wound healed in ten days, but was kept in hospital to be given a course of deep X-ray therapy as prophylaxis against recurrence. Radiographs taken at the time of operation showed no evidence of metastases in the lungs or skeleton.

Cystoscopy two months after the operation showed the scar in the bladder to have a somewhat keloid appearance, otherwise the bladder was quite normal.

OUTLOOK.—Judging from previously reported cases the outlook is poor. At present she is quite well and attending school again. At Professor Grey Turner's suggestion she is to undergo a course of prophylactic treatment with Coley's fluid, and she will, of course, have regular cystoscopic examination. If local recurrence occurs a total cystectomy will be advised after uretero-intestinal anastomosis.

In September, 1937, the child is healthy and the bladder normal.

AETIOLOGY AND PATHOLOGY

Sarcoma of the bladder has been found most commonly at two periods of life, in children from 1 to 10 years of age, and in adults of between 40 and 70 years of age. Cecil analysed 185 cases, and found 59 below the age of 10 years, 30 between 11 and 40 years of age, and 83 over the age of 40. (There were 13 cases whose ages were unstated in this series.)

It occurs as a single tumour growing in the bladder wall and projecting into the bladder cavity. It may begin in any region of the bladder, but it is most commonly present in the trigonal area or at the fundus. At first it is small, having a broad base, and is covered by the bladder mucosa which gives it a smooth surface. As it increases in size, it may either become pedunculated and mushroom-shaped, or remain sessile forming a semiglobular mass. It infiltrates locally in the substance of the bladder wall, and parts of this extension may project into the lumen at a distance from the primary site and give the appearance of multiple primary growths.

When the growth enlarges, it ulcerates and bleeds. Surface infection is common, resulting in phosphatic incrustation. Some of the recorded cases have grown so large that they formed big masses in the pelvis compressing the rectum and ureters; others have metastasized early to the regional lymph-glands and to the lungs.

Death is caused by involvement of the ureters or infection of the kidneys resulting in uræmia, or by lung metastases.

The chief pathological types are spindle-cell sarcoma, round-cell sarcoma, mixed-cell sarcoma, angiomyxosarcoma, lymphosarcoma, osteosarcoma (McCarthy). Leiomyosarcoma is very rare indeed, but Krauskopf collected three cases, including one of his own.

SYMPTOMS

Painless hæmaturia is the outstanding early symptom. In children it is continuous, in adults intermittent. Sometimes the bleeding is so profuse that clot retention results.

Difficulty in the act of micturition—even acute retention in children—may be the first symptom. Sometimes painful micturition draws attention to the disease, especially if cystitis is present.

Increased frequency is due as a rule to a complicating cystitis, but occasionally the actual bulk of the tumour encroaches on the bladder lumen to such an extent that there is a remarkable diminution of the bladder capacity, necessitating very frequent emptying. In some little children with sarcoma this evacuation of the urine occurs so often that they are regarded for a time as examples of essential enuresis.

Renal pain, due to involvement of a ureter by the growth, may be an early symptom and obscure the diagnosis, especially if hæmaturia is present. Sometimes so little discomfort is experienced by females in early stages of the disease that the sarcoma grows to a size big enough to be felt by the patient, and this type may be difficult to differentiate from an ovarian tumour.

DIAGNOSIS

The ordinary clinical examination of a patient with any of these symptoms may reveal a lump in the bladder region in advanced cases, but in early stages it is negative and the diagnosis depends upon cystoscopic examination.

Before submitting a child with hæmaturia to cystoscopy, it is imperative to exclude all the non-surgical renal and extrarenal causes of this symptom.

Most of the recorded cases of sarcoma of the bladder have been first discovered in an advanced stage, and it is noteworthy how often attempts to pass a cystoscope have failed, or the introduction of the instrument has produced such profuse hæmorrhage that the procedure was without value.

On cystoscopic examination in an early stage, a nodular tumour having a smooth surface is seen. The overlying epithelium may have an œdematous appearance. When the growth breaks down, it resembles an ulcerating carcinoma.

Cystoscopic diagnosis cannot be conclusive. All that can be said is that a solid tumour in children is commonly sarcomatous, and that in the very big tumours in adults the possibility of sarcoma should be borne in mind.

PROGNOSIS

The prognosis is very bad indeed, and the literature of this subject makes very melancholy reading. Albarran, Munwes, and Watson assess the immediate mortality in hospital after any type of operation at 50 to 60 per cent. Munwes collected 3 patients who were alive 5 years after operation. Mixter reported 1 case that lived for 2 years after operation and then died of pneumonia. Cecil recorded 1 patient who lived 1 year and 9 months after total cystectomy and then died of recurrence. Geraghty reported 1 patient, 22 years of age, who was alive and well 9 years after operation.

These are the best results; the vast majority of the patients die within six months of the diagnosis being made. Most of them are in such an advanced state

when first seen that only palliative treatment is possible. Radical treatment, such as partial or total cystectomy, is rarely attempted, and even when performed the ultimate results are disappointing. The only hope of improvement would seem to be in earlier diagnosis by thorough urological investigation of all patients presenting urinary symptoms.

TREATMENT

1. Transurethral Diathermy.—As might be expected this has been used on many occasions without influencing the course of the disease. It cannot even control the hæmorrhage.

2. Excision.—It is impossible to enucleate only the tumour, as its base infiltrates the bladder wall. If by excision with the scalpel or diathermy knife the bulk of the tumour is removed, the base should be well coagulated. This gives some symptomatic relief, but should be reserved for those extensive growths involving the trigone where total cystectomy is impossible.

3. Resection.—Partial cystectomy—that is, removal of all the tumour with a margin of healthy tissue—is the ideal operation for small growths. The disease is removed, and the normal anatomical arrangement and physiology of the bladder are preserved. Unfortunately, most of the growths are too big when first seen to allow this to be successfully accomplished, and as many of the growths of the bladder base infiltrate the trigone and involve both ureters partial cystectomy is not often possible.

4. Total Cystectomy.—This is often the only procedure that offers any hope of eradicating the disease. It has an immediate mortality of 50 to 60 per cent in the few sarcoma cases that have been done, and the results so far recorded have been disappointing. With the improvements in technique, however, the mortality should diminish and the ultimate results improve.

5. Deep X-ray Therapy and Radium.—These methods of treatment do not offer as much hope as radical surgical measures, and should only be used as palliatives when surgery is impossible.

The choice of treatment of operable growths, therefore, lies between partial cystectomy and total cystectomy. In small growths in children one hesitates to remove the bladder, and, if partial cystectomy will suffice to extirpate the growth, this should be advised. For bigger growths, or where the bladder base and trigone are involved, total cystectomy with surgical diversion of the urine to the bowel or skin should be advised, depending on the general condition of the patient.

Where the growth is so advanced that total cystectomy is impracticable, considerable relief can be afforded to the patient by surgical diversion of the urine, with or without local diathermy application to the growth.

I wish to thank Professor Grey Turner, Director of the Department of Surgery, British Post-graduate Medical School and Hammersmith Hospital, for permission to publish this case.

BIBLIOGRAPHY

CAULK, J. R., " Sarcoma of the Bladder," *Jour. of Urol.*, 1926, xvi, 211.
CECIL, H. L., " Sarcoma of the Bladder ; Report of Case upon whom a Total Cystectomy was Done ", *Ibid.*, 471.

MACKENZIE, D. W., and CHASE, W. H., "Rhabdomyosarcoma of the Urinary Bladder with Metastases. Report of Case with Brief Review of Clinical and Pathological Literature", *Ibid.*, 1928, xix, 315.
STEPITA, C. T., "Sarcoma of the Bladder; 2 Cases", *Amer. Jour. Surg.*, 1928, v, 406.
MCCARTHY, J. F., and others, "Sarcoma of the Bladder", *Ibid.*, 1929, vii, 229.
HAGER, B. H., and HUNT, V. C., "Report of Case of Leiomyosarcoma of the Bladder", *Jour. of Urol.*, 1929, xxi, 129.
BRYAN, R. C., "Sarcoma of the Bladder", *Ibid.*, 695.
MACKENZIE, D. W., and HAWTHORNE, A. B., "Small Round-cell Sarcoma of the Bladder, with Review of the Literature", *Trans. Amer. Assoc. Gen.-Urin. Surg.*, 1929, xxii, 313; also *Brit. Jour. Urol.*, 1929, i, 359.
CAYLOR, H. D., and WALTERS, W., "Leiomyosarcoma of the Urinary Bladder", *Jour. of Urol.*, 1930, xxiv, 303.
LAZARUS, J. A., and ROSENTHAL, A. A., "Myxosarcoma of Bladder; Case Report of Child 2 years of age", *Ibid.*, 1932, xxvii, 695.
GABE, J., "Case of Sarco-carcinoma of Urinary Bladder, with Brief Review of Literature of Sarcoma of Bladder", *Brit. Jour. Urol.*, 1932, iv, 145.
POWELL, B. F., "Case of Leiomyosarcoma of the Bladder", *Ibid.*, 259.
KRAUSKOPF, H., "Report of Unusual Case of Leiomyosarcoma Occurring in Urinary Bladder", *Amer. Jour. Obst. and Gynecol.*, 1932, xxiv, 133.
KRAUSKOPF, H., "Leiomyosarcoma; Analysis of 31 Recorded Histories with Report on Unusual Case in Urinary Bladder", *Amer. Jour. Surg.*, 1933, xxii, 192.

THE EVOLUTION AND DEVELOPMENT OF SURGICAL INSTRUMENTS

By C. J. S. THOMPSON, M.B.E., Ph.D.
HON. CURATOR OF THE HISTORICAL COLLECTION, MUSEUM OF THE ROYAL COLLEGE OF SURGEONS OF ENGLAND

II. THE AMPUTATION KNIFE

According to Aryan tradition, Sūsruta, a disciple of Dhanvantari the Hindu Father of Medicine, records in *Samhita* his book on Surgery, said to have been written about 600 B.C., a hundred and twenty-one surgical instruments in a chapter he devotes to the preparation of a surgeon for accompanying the king to the battle-field. He enjoins that " the instruments should have good handles and firm joints, be well polished and sharp enough to divide hair. They must be kept perfectly clean and wrapped in flannel in a wooden box but the best and most important of all is the hand."* Amputation, he states, was done now and then, notwithstanding the want of good control over the hæmorrhage. Boiling oil was applied to the stump by pressure by means of a cup-formed bandage; pitch being sometimes added.

There is a close correspondence between Sūsruta's writings and the Hippocratic collections, and some of the operations he describes agree with the accounts of Alexandrian practice and those given by Celsus.

It is not, however, until the first century of the Christian era that we have a description of the amputation of a limb. Aulus Cornelius Celsus (25 B.C.–A.D. 50), in his account of the operation, says: " When the malady gets the better of our medicines the limb must be amputated, but this is attended with great danger, for often during the operation itself the patients die from the hæmorrhage or from deliquium. But in cases like this where we have but one remedy, expediency and not safety is the paramount consideration. We are therefore to make an incision with a knife between the sound and morbid parts down to the bone, with this qualification, that we are never to cut opposite a joint and always to include some of the sound part rather than leave any of that which is diseased. When we come to the bone, the sound flesh must be retracted so as in some measure to denude it; then it must be divided with the saw close up to the sound flesh. The end of the bone is then to be smoothed where the saw has left any asperity and the integuments brought over it, which, in this operation ought to be left loose enough to cover the entire stump or as far as possible. When the stump happens not to be covered with integument it must be dressed with lint and over that a sponge dipped in vinegar is to be secured by a bandage."†

The knife used by the Roman surgeon, judging from the specimen found among the surgical instruments discovered at Pompeii, was shaped like a large scalpel with a steel blade and bronze handle (*Fig.* 284, 1).

That stumps were sometimes fitted with artificial limbs is evidenced from

* Jamini Bhushan Roy, *Report on Indigenous Systems of Medicine*, Part I, Madras, 1923.
† Celsus, Book VII. Cap. 33.

the leg made of bronze plates fashioned to a wooden core (*Fig.* 283). This unique relic of orthopædics, now in the Museum of the Royal College of Surgeons, was excavated from an undisturbed tomb near Capua. It was probably intended to

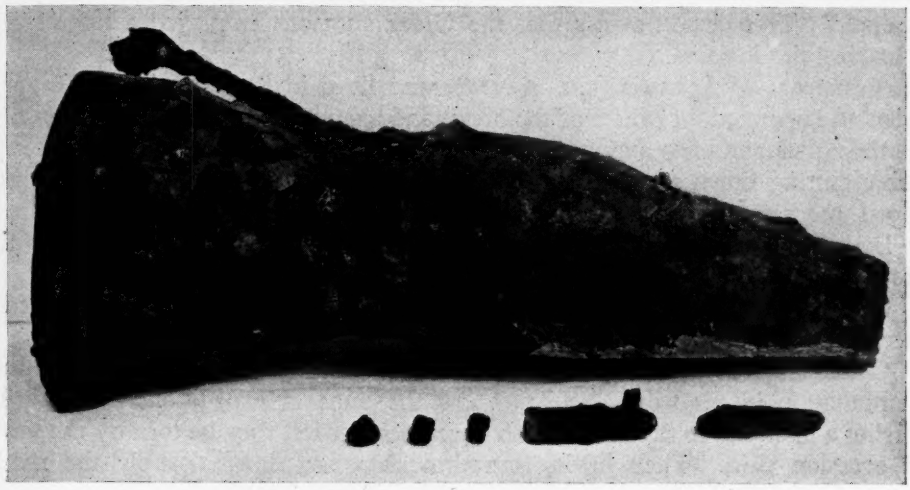


FIG. 283.—Roman artificial leg of bronze, *c.* A.D. 300. (*Museum of the Royal College of Surgeons of England.*)

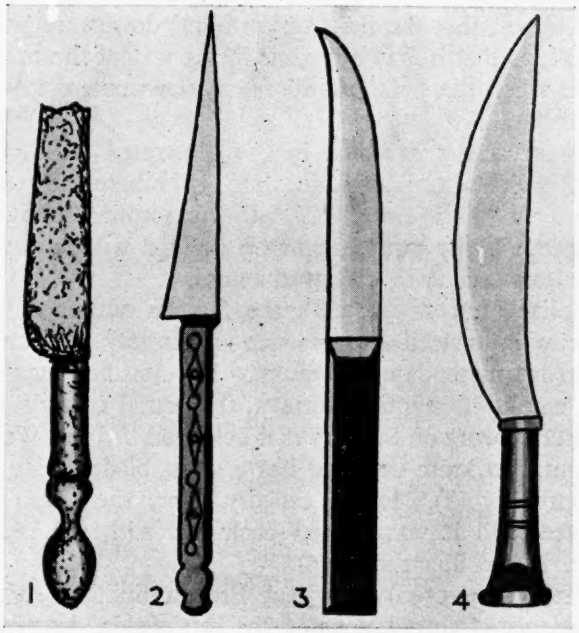


FIG. 284.—Amputation knives: 1, Roman; 2, Albucasis; 3, Wryghtson, 1350; 4, Knife of the fifteenth century.

replace the right leg, as the skeleton found with it had a waistband of sheet bronze edged with small rivets made to fasten to a leather lining. Two iron bars, having holes at the free ends, are attached to the extremity of the bronze, and a quadrilateral piece of iron found near the position of the foot was probably fixed to the leg below so as to strengthen it.

Among the leading Greek surgeons of the first century was Heliodorus (A.D. 75), who was contemporary with Juvenal. On amputation he observes: In sawing the bone the plate of the saw ought to be applied even, in order that the sawing of the bones be even. When the bones are sawn, cut through the other parts with a scalpel." This clearly shows that the Greek surgeons employed a large scalpel for making the incision.

Archigenes of Apameia (A.D. 48–117), who lived in Rome under the Emperor Trajan and operated for cancer of the breast and ligatured bleeding vessels, described both the circular and flap amputation. With respect to the latter operation he says: "After cutting down to the bone the tendons are to be retracted and the bone scraped and sawn."

Both these surgeons employed ligatures, which we are told in Galen's time were "to be bought at a shop in the Via Sacra."

Galen (A.D. 130–200?) himself recommends amputation to be performed in general at a joint in certain cases of gangrene.*

Coming to the seventh century, Paulus Aegineta (A.D. 625–690), who alludes to amputation in his works, says: "Saw the bone as expeditiously as possible, applying a linen rag to the parts which have been cut lest they be torn by the sawing and occasion pain. Then having cut through what remains, apply the red-hot irons and stop the hæmorrhage thereby with compression."†

The Arabian School performed amputations as early as the tenth century and also practised excisions of the bones and joints. Rhazes (850–923 A.D.) observes, on the sawing of bones, that the flesh upward and downward should be stretched with a piece of cloth so that it may not come in the way of the back of the saw. He recommended that when the bone was diseased, the whole diseased portion should be cut out.

Among the instruments depicted in the illustrated MSS. of Albucasis (A.D. 936–1019) is a knife with a straight blade, wide at the base and narrowing to a sharp point, which he calls a "knife-razor" (2). In the account he gives of amputations it is directed that the fleshy parts are to be divided with a large scalpel down to the bone, which afterwards is to be sawed across.

Gui de Chauliac (A.D. 1298–1368), the famous author of *Chirurgia Magna*, which for centuries influenced the practice of surgery in Europe, followed the Arabian School in his methods of operating. He classified hæmorrhage as arterial and venous, and employed styptics, sutures, the actual cautery, and ligation.

In the manuscript work on Surgery that belonged to John Wryghtson of Oxford in 1350, the amputation knife depicted has a short blade which is curved slightly inward at the extremity (3). But a century later, the shape of the blade was completely changed, and it was curved backward with the cutting edge on the outside, as shown in the illustration (4).

Ambroise Paré (1509–1590) the great French military surgeon, who gained much of his experience of amputations on the battlefields, describes in his *Chirurgie* two knives that he used when operating. One he calls an incision knife and the other a "crooked knife for dismembering", the blade of which is crescent-shaped with the cutting edge on the inside. He remarks, "when you have made your

---

* *Galeni Commentar. De Articulis*, Basle T.V., p. 650.

† *Works of Paulus Aegineta*, vol. ii, p. 409.

ligature, cut the flesh even to the bone with the sharp, well-cutting incision knife or with a crooked knife" (*Fig.* 285, 5, 6).

Among the instruments figured in the works of Andreas Vesalius (1515–1564) is an amputation knife with a large blade slightly curved part way at the back and with an almost straight cutting edge which is rounded off at the point (7). The wooden handle is decorated and terminates in a knob curving inwards to give firmness to the grip. In 1594, Guillemeau figured another type with a broad blade curved only at the extremity (8); but fifty-two years later, Fabricius Hildanus describes a new-shaped blade which differs widely from its predecessors (*Fig.* 286, 9).

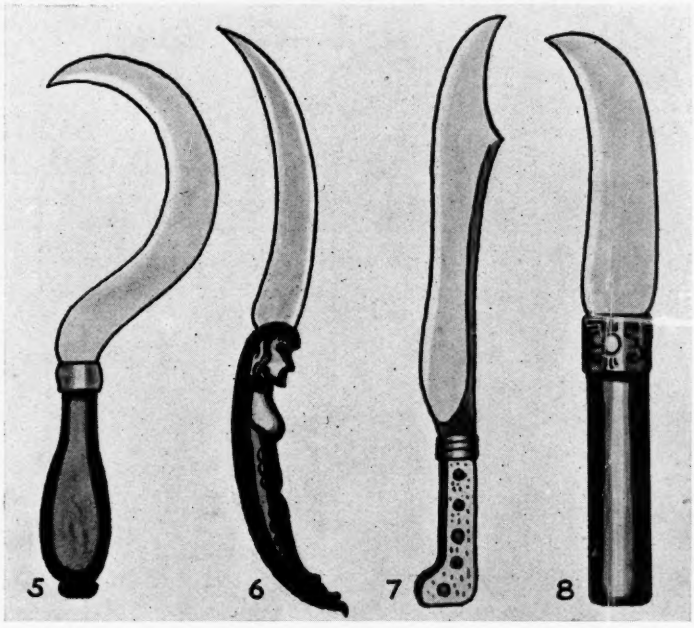


FIG. 285.—Amputation knives: 5, Paré's crooked knife; 6, Paré's incision knife; 7, Vesalius, *c.* 1550; 8, Guillemeau, 1594.

Shaped like a scimitar, it has the cutting edge on the outside of the curve of the heavy blade, while the back is bevelled and sharp. The handle of lignum vitæ is highly turned and finished.

But this innovation did not last long, judging from the *Armamentarium Chirurgicum* of Scultetus (1663), for he reverts to the earlier type, and calls his instrument a "crooked knife wherewith the flesh is cut in so far as the bone which must be saw'd off and is necessary before the amputation of the leg or arm (10).

During the first half of the eighteenth century several important changes took place in the shape of blades. About 1739 Sharp introduced his strongly curved blade which sometimes had a double edge (11), and later Perret favoured a still more crescent-shaped knife with a periosteal elevator which was used in France until late in the century for the amputation of the arm and lower extremity below the knee (12).

From 1760 to 1780 the curved blade of varying shape was in general use, and so remained until eight years later, when Loder advocated a knife with an almost straight edge which he found to be effective (*Fig.* 287, 13).

Then came a period of transition during which the straight-bladed knife began to replace the strongly-curved type used by Sharp and other surgeons in the earlier part of the century. Benjamin Bell figures a straight knife in his *System of Surgery* in 1788, and Savigny ten years later illustrates a knife with a blade intermediate between Bell's and Perret's, and points out that " care should be taken in the construction of this instrument that the back is not thicker than is absolutely

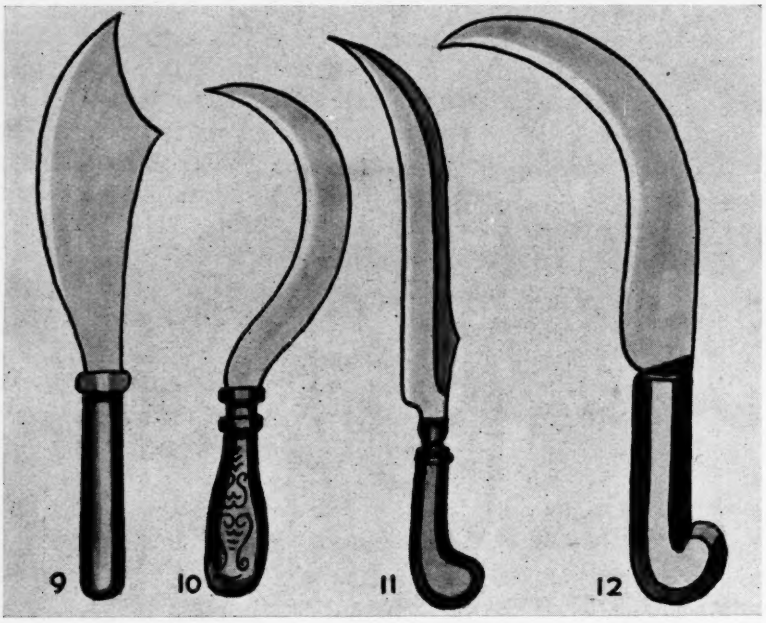


FIG. 286.—Amputation knives: 9, Hildanus, 1646; 10, Scultetus, 1665; 11, Sharp's curved knife, *c.* 1739; 12, Perret, 1772.

necessary to give and support the required firmness of edge, otherwise it becomes unwieldly in its management" (14). Sir Astley Cooper, however, preferred the broad back for his amputating knife, which is in a case of his instruments now preserved in the collection in the Museum of the Royal College of Surgeons. It has a very thick back with the sides of the blade much smoothed along its borders, but the blade is straight, slightly curving to a blunt point. A marked flattening of the blade on each side of the back is characteristic of this pattern. The ivory handle which came into vogue about this time is smoothly chequered, but most of the handles of the period are made of lignum vitæ and shaped octagonally with the terminal either curved inwards or outwards.

Lisfranc, who preferred straight-bladed knives for amputation, observes that " when a knife is required for the forearm or leg, the cutting edges should be extended to the insertion of the blade into the handle. He therefore had his knives made with long, slender blades with double edges (15).

Thus, about the mid-nineteenth century the fashion of the long straight blade came into favour and its use was established by Robert Liston in 1846. The skill and rapidity with which this brilliant surgeon performed his operations is well illustrated in the story of the historic occasion when he amputated the thigh of a man at University College Hospital on December 21, 1846. The patient had been placed under ether for the first time in this country. He had been successfully anæsthetized, and Liston, having selected one of his favourite long, straight knives, turned to the students and others who crowded the theatre saying, " Now gentlemen, time me."

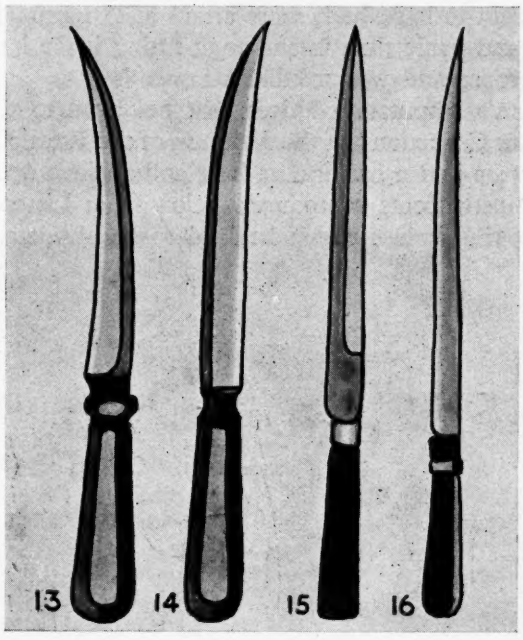


FIG. 287.—Amputation knives: 13, Semi-curved, 1775: 14, Savigny's; 15, Lisfranc's; 16, Liston's.

The operation was completed.

" Twenty-eight seconds," exclaimed Squire, who stood watch in hand.

" Twenty-seven ", cried Bucknell.

" Twenty-six ", said Russell Reynolds.

" Twenty-five ", quietly remarked Edward Palmer, Liston's dresser, and the surgeon smiled in reply.*

Some of the knives Liston employed had blades over a foot long which finished with a dagger point, the backs being sharpened for the last two inches. The cutting edges were almost straight till they curved upwards near the free ends to meet the backs (16). He thus explains his reasons for favouring the long, slender blade in his *Practical Surgery* :† " The form and size of the instrument ought always to be in proportion to the extent of the proposed excision as regards both their length and depth. Nothing can possibly be imagined more abominably cruel, for instance,

* C. J. S. THOMPSON, *Lister*, 1934, p. 15. John Bale and Danielson.

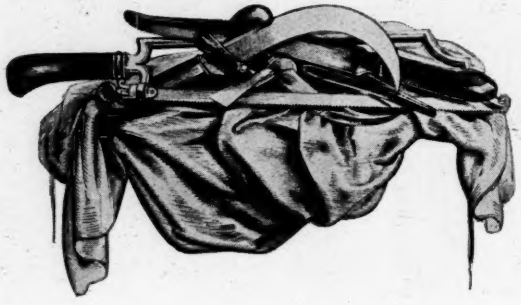
† ROBERT LISTON, *Practical Surgery*, 4th edition, 1846.

than the attempt (which has to my knowledge been repeatedly made and which I have in fact witnessed) to remove the lower extremity of a full-grown person with a common scalpel or dissecting knife. If an extensive incision is necessary, an instrument possessing sufficient length of edge must be employed so that the parts may be separated smoothly and quickly."

Liston insisted that the handle of a surgical knife should be perfectly smooth and polished, as in fact, he observes, ought to be the handles of all instruments in the use of which delicacy of touch is necessary. " Some practitioners " he continues, " have carried fashion so far, that many even of the catheters and sounds are to be found fitted with wooden handles, deeply grooved and chequered. The inventors of these seem to have been more afraid of losing hold of the instrument in a fit of agitation and panic than intent upon fitting it for its legitimate purpose and using it in a proper and workmanlike manner ".

A pair of Liston's amputating knives that belonged to Syme of Edinburgh are now in the ' Lister Collection ' in the Museum of the Royal College of Surgeons. The blades are fourteen and a half inches long and an inch and a quarter deep.

The trophy of instruments reproduced below from Liston's work is said to represent the amputating knives which he held to be obsolete.



GASTROPTOSIS

By H. STIVEN

PRINCIPAL MEDICAL OFFICER, DEMERDACHE HOSPITAL, CAIRO

THIS paper might be entitled "The Luck of the Enthusiast". I performed the Lambret suspension operation for gastroptosis on two dogs, in order to follow up what happened to the band, which is threaded through the tunnel composed of the anterior wall of the stomach. Unfortunately one dog escaped and was lost, and the other died soon after operation. However, for the Final Surgery Examination at the Faculty of Medicine, Cairo, where I am one of the visiting examiners, I was given an embalmed body for surface markings and operative surgery. I found the two scars of a Lambret operation, and this was a patient I had operated upon

FIG. 288.—Two white scars, median and over left rectus, the result of an operation for gastroptosis.

for gastroptosis at Demerdache Hospital during the International Surgical Congress, Cairo, in January, 1936, and had seen in good health five months later. He had died of acute nephritis and heart failure in December, 1936, in Kasr el Ainy Hospital. (*Fig.* 288.)

Gastroptosis is part of a vicious circle which is extraordinarily hard to break. There is a mental and psychic apathy and loss of tone due to the prolapse of the abdominal organs, and the prolapsed abdominal organs are in no way helped by the mental apathy. The actual dilatation and prolapse of the stomach causes indigestion and accumulation of toxic products, only to be got rid of by the steady

will power to submit to a regular stomach tube and wash out, and constant wearing of a well-fitting belt. Other medical means are many and various, but the melancholy and lack of vitality in these patients is an insuperable handicap in well-advanced cases.

Surgical methods of cutting this vicious circle have also been many and various, and until Professor Lambret, of Lille, devised this operation, have also had serious defects. The operation is to take an aponeurotic band from the anterior wall of the sheath of the left rectus muscle, leaving it attached by the end near the ribs; pass this band between the ribs into the abdomen; sling up the stomach, by making a tunnel from the anterior wall of the stomach for this band on which the organ may slide to and fro; and then fix the band to the pyloric region of the stomach, attaching the extreme end to the round ligament of the liver. The stomach is thus suspended and functions normally. If the liver is also prolapsed, which is often the case, I find it useful to fold up the base or edge of the falciform ligament containing the round ligament, and by rolling the liver upwards and backwards, gain a shortened attachment to the diaphragm and costal wall. The effect of this is to get two skeletal attachments for the suspensory band, the ribs and the xiphisternum, and the stomach, so to speak, is given a second lesser curvature. The prolapsed transverse colon has also a chance to recover its normal tone and position.

TECHNIQUE OF OPERATION

A median incision is made from the xiphisternum to the umbilicus and the abdomen is thoroughly explored—appendix, gall-bladder, duodenum—and a search made for stenosis of the pylorus, or any abnormalities not revealed by the routine pre-operative barium meal and X-ray examinations. A tetracloth is attached to the right edge of this incision.

The configuration of the patient's chest wall is next studied, from within the abdomen and superficially, to decide through which intercostal space the band will pass; the pleura naturally is to be avoided. A second incision is now made, starting just above the point selected and extending well below the level of the umbilicus; the incision should expose the sheath of the left rectus muscle. (*Fig.* 289.) A band 2 cm. in width and about 14 to 16 cm. in length is dissected off the surface of the muscle. A commencement is made at the lower end, and the separation is found to be quite easy, but care must be taken at the sites of the intermuscular septum, where dissection may be difficult. If the detachment is started above and below the septum, it is possible to free the band without weakening it. The upper end of the band, where it approaches the site chosen for the penetration of the intercostal space, is cut a little broader and is not dissected off, but left firmly attached.

A suitable instrument, a long Kocher or a bullet extraction forceps, is now passed from the abdominal cavity through the intercostal space chosen, and comes out well above the end of the dissection of the band. The detached end of the band is seized and threaded through into the abdomen. The passage of the instrument is usually made without the use of the scalpel. The band has now a solid attachment to the rib below and is folded upon itself as it penetrates the space. (*Fig.* 290.) The superficial wound is covered with an abdominal sponge, and a tetracloth is placed in position on the left edge of the median incision.

The stomach is now delivered from the abdomen and pulled well down so that the beginning of the tunnel to be formed from the anterior surface may be as high up as possible. The tunnel is made by picking up, with a round needle

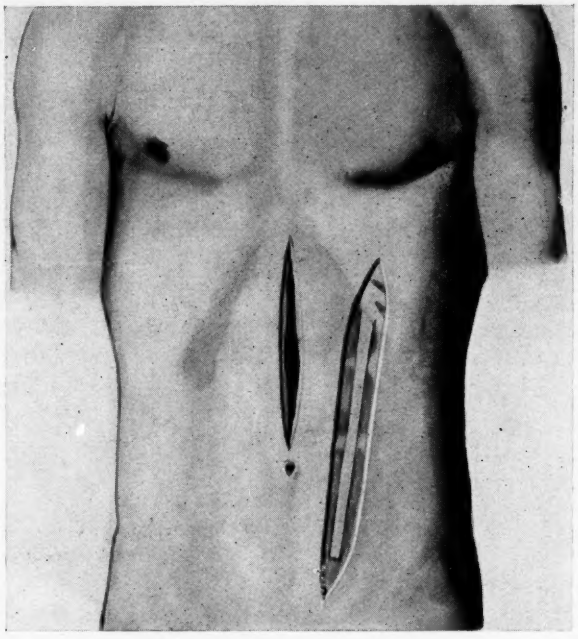


FIG. 289.—Lambret's operation: median and lateral incisions.

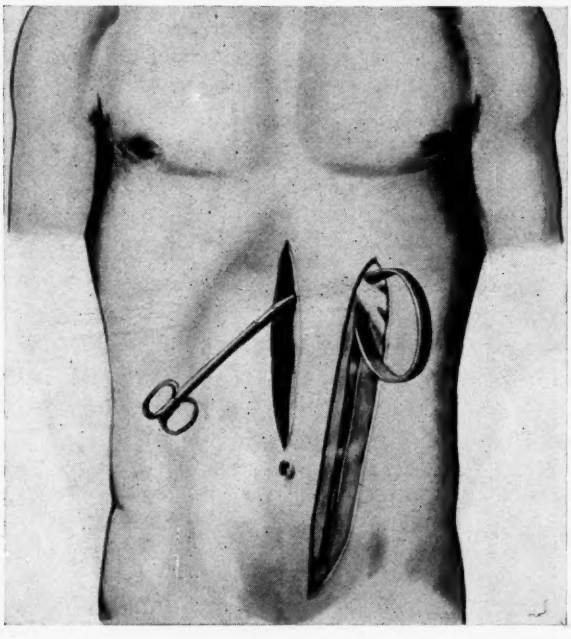


FIG. 290.—Lambret's operation:: the band perforating the chest wall.

threaded with a continuous silk suture, the muscular coat of the stomach at the greater curvature and at a short distance superior to this, on the anterior wall of the stomach; the band is buried in this tunnel-like fold; the stitching is continued;

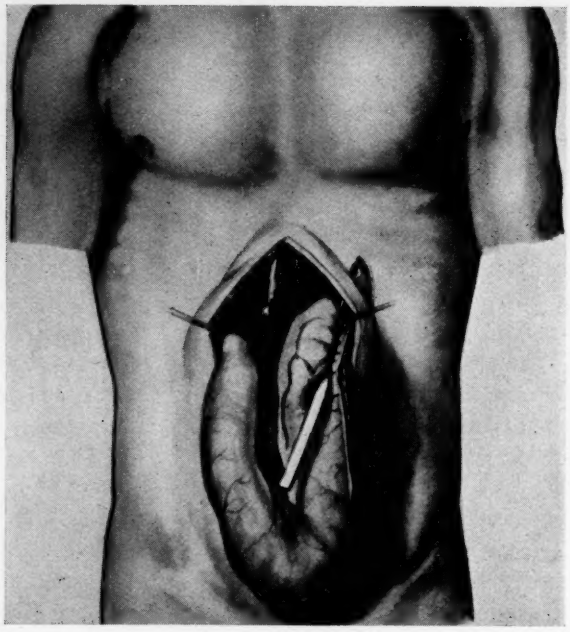


FIG. 291.—Lambret's operation: the tunnel being formed.

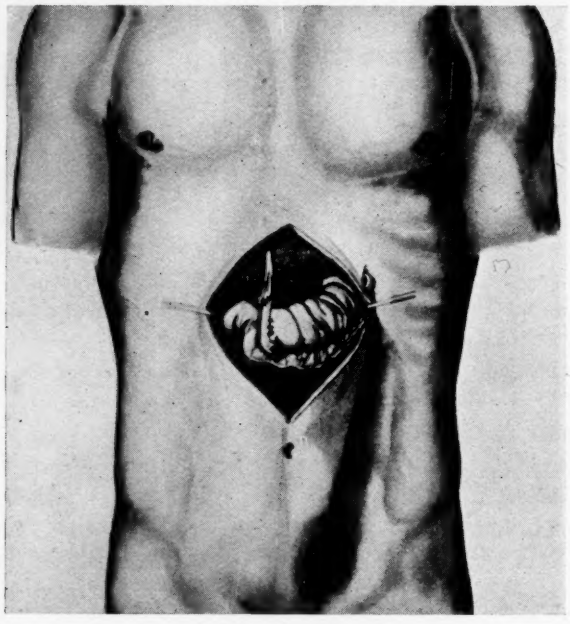


FIG. 292.—Lambret's operation: the gastroptosis relieved.

the large vessels running upward from the greater curvature are easily avoided, and little by little, the stomach is threaded on to the band until the pyloric end is reached. Here care is taken not to take up too much of the stomach wall for fear of narrowing the lumen of the organ. The continuous suture is now ended. (*Fig.* 291.)

Three centimetres from its extremity the band is firmly attached to the muscular coat of the stomach by two or three interrupted sutures. The band, hitherto, has been following the longitudinal axis of the stomach; the direction is now changed, and these interrupted sutures fix the band across this axis, following a direction parallel to the pyloric sphincter.

The extreme end of the band is now fixed to the round ligament of the liver. The length used depends upon circumstances; it is found that the dilated and fallen stomach can be folded up with a concertina-like effect on the band, and a suitable amount of play is allowed. (*Fig.* 292.)

Lambret recommends that care should be taken in making the tunnel to ensure that the band is not transfixed by the stitches, so that the stomach may be able to slide to and fro, and I see no reason to modify this advice, although the specimen and microscopical sections show that subsequently the band has become fused with the stomach wall.

If the liver also is ptosed, and not lying in close apposition to the diaphragm, it is possible, at this stage, to rotate the liver backwards and to shorten the edge of the falciform ligament and gain a firm attachment to the costal wall for both the liver and the band supporting the stomach.

The median incision is now closed in the usual way. The left lateral incision is also closed. I do not join the cut edges of the rectus sheath unless these are very slack and easily approximated; our specimen shows that this gap has been satisfactorily closed by Nature. I place a layer of subcutaneous sutures, and close the skin with Michel clips.

The patients follow the ordinary post-operative routine for laparotomies, and a light diet is enjoyed on the fourth day.

POST-OPERATIVE RESULTS

My cases, eight in number, are under close observation, and all, with the exception of the subject of this article, are in excellent health, are cured from their indigestion and lassitude, and have put on weight. Two complained of pain at the site of the perforation of the intercostal space, but this soon passed.

The deceased man was seen in May—that is, five months after operation—and was then very well and enjoying his meals. Some cold weather in December was probably the cause of his acute nephritis; there had been no albumin in the urine at the time of operation. The hospital report is as follows:—

Record of Patient in Kasr el Ainy Hospital:—
No. 28549—medical—admitted Dec. 17, 1936; stayed one day.
Name: A. S. I., 40 years.
Diagnosis: Myocardial failure (congestive).
Treatment: Digitalis mixture, Mist. diuretica, etc.
Result: Death, 4.30 a.m., Dec. 18.

Notes: History of dyspnœa and œdema of face and legs for six days. Examination revealed: puffiness of eyes; heart, weak and rapid; lungs, rhonchi, prolonged expirations all over and crepitations; abdomen, liver enlarged and tender; urine, albumin + +; œdema of legs and feet. Condition bad. Duration of illness, six days. Diagnosis: congestive heart failure, nephritis, bronchitis.

The gastroptosis, as may seen in the radiograph taken before operation (*Fig.* 293), was well marked, and the stomach was in the pelvis; five months after operation it was in good position (*Fig.* 294), and post mortem was found to be in a natural comfortable position and not dilated or ptosed.

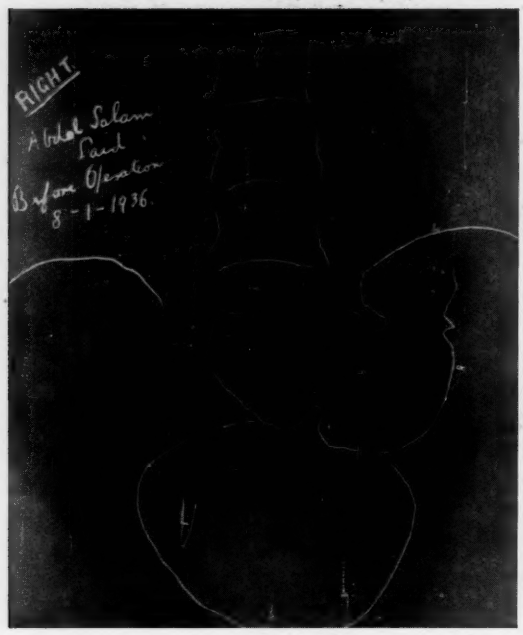


FIG. 293.—Radiograph after barium meal, January, 1936, showing well-marked gastroptosis.

FIG. 294.—Radiograph after barium meal, May, 1936, five months after operation. The patient stated he was in very good health and relieved of all his previous symptoms.

Post-mortem Findings.—There were numerous light adhesions between omentum and the peritoneum, lining the upper part of the abdomen, but not to the extent of a Talma-Morison operation. The stomach and transverse colon were in good normal position. The aponeurotic band could be clearly seen coming through the chest wall into the abdomen, and its attachment to the round ligament of the liver was firm. The aponeurosis on the front of the external rectus muscle was healed over, and there was no sign of protrusion or hernia of the muscle through this gap (which at operation I do not close). The band itself was found to be fused with the anterior wall of the stomach. The power to slide to and fro on the band was abolished. However, it is conceivable that the elasticity and movement possible immediately after operation may allow the stomach to arrange itself on its new support more agreeably than if the band were arbitrarily attached to the wall for the whole of its length. (*Figs.* 295, 296.)

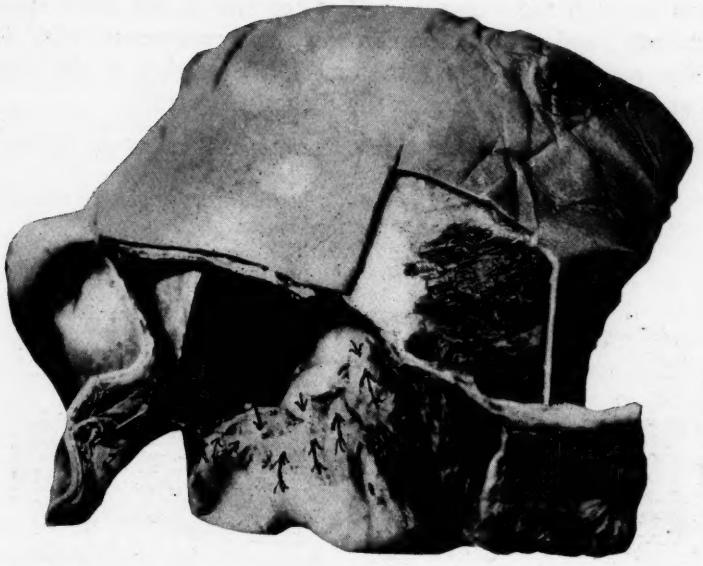


FIG. 295.—Showing the band fused with the stomach wall. When the transverse skin and muscle incision is replaced the level of the stomach is well up in the abdomen.

FIG. 296.—Photograph of drawing of the specimen, now in the Museum of the Faculty of Medicine, Cairo.

A section through the stomach wall at the site of the band shows a fold of mucous membrane, and under the microscope the aponeurotic band is seen to be fused with the muscular wall of the stomach; a portion of the continuous silk suture used at operation is present in the section (*Fig.* 297).

HISTOLOGY (Report of Professor Bernard Shaw, of the Pathology Department at Kasr el Ainy Hospital).—

Specimen. Piece of stomach wall 3·0 cm., taken at right angles to the line of insertion of sheath of rectus muscle, following Lambret operation.

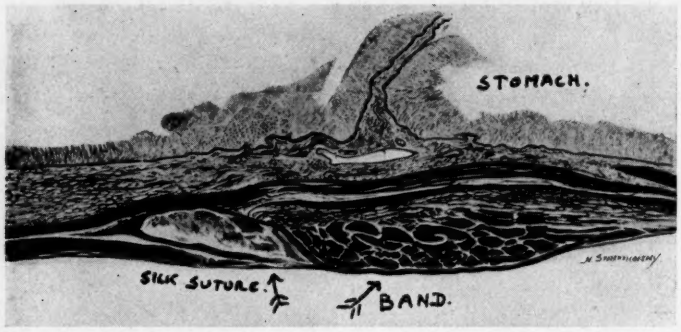


FIG. 297.—Photograph of drawing of section under low power of microscope, showing the band fused with the muscular coat of the stomach wall and the silk suture.

In the subserous coat of the stomach is an elliptical mass of aponeurotic tissue most of of which lies external to the muscular coat. But at one place there is a breach in the muscular coat, and this is filled by one pole of the aponeurotic tissue. At this site there is a foreign substance (presumably surgical silk suture) embedded in the aponeurosis, and around it is a cellular and foreign body giant-cell reaction. Although the aponeurotic tissue is clearly identifiable its margins fuse imperceptibly with the surrounding connective tissue. The submucosa and mucosa present no abnormality. The latter, however, is a prominent fold about 3·0 mm. long, opposite to the insertion of the aponeurosis.

It is clear from the histological appearances that the aponeurosis has become an integral part of the stomach wall, and it is difficult to imagine the stomach being capable of sliding along the aponeurosis.

CONCLUSIONS

A post-mortem specimen is described of a case for which a suspension operation for gastroptosis had been performed one year before death from acute nephritis.

The technique of the operation is described.

The operation is eminently successful in cutting the vicious circle of symptoms and effects, and deserves to be more widely known and practised.

I have to thank Dr. Bulgakoff and Dr. Sidhom for dissecting the specimen and preparing it for the Museum of the Faculty of Medicine at Kasr el Ainy; also Mr. Strakilovsky for his illustrations.

BIBLIOGRAPHY

LAMBRET, *Arch. de Gastro-Enterologie*, 1931, May.
LAMBRET, *Presse méd.*, 1929, Dec. 11.
BONNET AND GINESTET, *Bull. Soc. Chir. de Paris*, 1933, xxv, Feb. 3, 120.
STIVEN, *Jour. Internat. de Chir.*, 1937, Jan., ii, No. 1.

THE PROBLEM OF THE BLEEDING PEPTIC ULCER

By GORDON GORDON-TAYLOR, London

In respect of the maladies of the stomach, the debt of surgery to Vienna is admittedly considerable; not only must Theodor Billroth be hailed as the real founder of gastric surgery, for it was the experimental work of Gussenbauer and Winiwarter in his Clinic and his own pioneer surgical endeavours in gastric suture on the human stomach that paved the way for modern technique, but to Mikulicz, another former assistant of the illustrious surgeon, belongs the credit of priority in operating for gastric hæmorrhage—half a century ago.

Still one more distinguished alumnus of the famous Austrian school, Hans Finsterer, has now come forward urging early operation for the hæmorrhage of chronic peptic ulcer, and by his statistics demonstrating the safety of surgery for this complication, at least in his skilful hands.

SURGERY AND HÆMORRHAGE FROM ACUTE PEPTIC ULCER

Conflict of opinion between physician and surgeon can rarely arise in connexion with the bleeding of acute peptic ulcer. I have always entertained the opinion that hæmorrhage due to this cause scarcely ever requires surgical treatment; bleeding from this source can be combated by medical measures and by the transfusion of blood. Nevertheless, a certain small mortality of 2 to 4 per cent is attached to the condition, and in a few cases which do not respond to non-operative means and where *life itself is gravely menaced*, recourse to surgery may be necessary.

Before any operative attack on such cases be contemplated it is manifestly of paramount importance to exclude from the diagnosis such conditions as the hæmorrhage diathesis (angiostaxis of Tidy[1]), exceptional disease of the gall-bladder, cirrhosis of the liver, or a septicæmia due to an infection with a hæmolytic streptococcus, in which surgery is either obviously contra-indicated or, if demanded, certainly involves no direct interference with the stomach itself. Such diseases, in point of fact, rarely require urgent surgery, although I have recorded elsewhere a case of thrombocytopenia[2] where the spleen was removed as an emergency operation in the earliest hours of the morning at the earnest desire of a physician-colleague, and I have met with the most fearsome hæmatemesis associated with hæmoperitoneum in a patient with an acute inflammation of the gall-bladder due to an intense *B. welchii* infection[3]; in this case the presence of a tender tumour in the right hypochondrium not only made the diagnosis easy, despite the alarming cataclysmic complication, but also directed the line of operative attack.

My opportunities for dealing surgically with the hæmorrhage of acute ulcer have been almost exclusively provided by medical confrères who have invited assistance after unsuccessful efforts at hæmostasis by non-operative measures. Transfusion of blood, especially 'drip-transfusion', has fortunately restricted the activities of the operator, but where surgery has been deemed necessary by all concerned in the treatment of the case, my own predilection nowadays is for

gastrotomy, an opening of sufficient size being made to enable the gastric mucosa to be thoroughly inspected; the individual bleeding vessels are controlled by ligature or mattress sutures inserted from inside the viscus; the erosions which are the source of the hæmorrhage have been usually found towards the lesser curvature of the stomach.

In four patients, two males and two females, operated upon ' à chaud ' before the War, the *gastrotomy* was *supplemented by a gastrojejunostomy*; all these patients recovered. In the few cases with which I have dealt in recent years, I have refrained from a superadded gastrojejunostomy; the ' blood-drip ', even if it may not have always succeeded in arresting the hæmorrhage,* nevertheless has proved a most valuable aid to surgical incursion, and its employment before, during, and after operation has contributed to the success of the intervention. In several patients who after operation have not progressed to one's entire satisfaction, the adoption of the Meulengracht[4] règime† has appeared to weight the scale in their favour.

The two occasions on which I have refrained from doing more than a mere jejunostomy have both been disastrous; the operation may be simple and speedy, but for the bleeding of acute ulcer it is uncertain and to be condemned.

OPERATIONS FOR HÆMORRHAGE FROM ACUTE PEPTIC ULCER

OPERATION.	NUMBER	RECOVERY	DEATHS
Gastrotomy + ligature or mattress-suture of bleeding vessels + gastrojejunostomy	4	4	–
Gastrotomy + ligature or mattress-suture of bleeding vessels	3	3	–
Jejunostomy	2	–	2
Exploration with negative findings in stomach and duodenum	2	2	–
Total	11	9	2

Sir James Walton,[8] while admitting that there are certain cases of hæmorrhage from acute peptic ulcer that require operation, counsels pyloric occlusion and gastrojejunostomy for these, adding that if the surgeon does not think that indirect methods will control the bleeding the case had better remain untouched. There is a Scottish motto, ' Mak siccar ',‡ and direct attack at the very source of the bleeding is, in my opinion, more likely to prove effective than measures of an indirect nature.

The administration of adrenaline by mouth has also been suggested for

* Despite the statement to the contrary by Cullinan and Price, increasing experience gives me added confidence in the hæmostatic properties of drip-transfusion.

† Support for the Meulengracht method is afforded by the gastrographic investigations of Oline Christensen,[6] which showed that a fairly well-filled stomach is all the time relatively at rest, the continuous contraction waves being very much weaker than those of the starving, empty stomach; and also by the work of my friend John B. Hunter on the action of saliva on the clotting-time of bleeding in the stomach.[7]

‡ Make sure.

such patients, and although I have by this means satisfactorily controlled even serious hæmorrhage from an acute peptic ulcer, this preparation, even when recommended in considerable dosage, is hardly likely to arrest permanently the severe bleeding of a chronic gastric or duodenal ulcer; only a blind optimism can sanction any prolonged employment of this form of therapy.

Even when a chronic peptic ulcer has been present, recurrent hæmorrhage may not always be due to a reactivation of the original ulcer or to the breaking down of the scar, but may come from an acute ulcer or ulcers in the vicinity. From the operator's point of view the distinction is an academic one; the principles underlying the surgical attitude towards the bleeding of chronic ulcer should direct the treatment.

THE SURGERY OF THE HÆMORRHAGE OF CHRONIC PEPTIC ULCER

It is, of course, the surgical attitude to the bleeding of *chronic* peptic ulcer that forms the burden of this communication. The subject may be discussed under the following headings :—

1. The role of surgery as a *prophylactic measure* against the bleeding of chronic peptic ulcer.
2. The indications, if any, for surgery in cases presenting *a history of one or more hæmorrhages* and unequivocal proof of the existence of a chronic peptic ulcer in which no bleeding is taking place at the moment.
3. The surgical attitude towards cases of indubitable chronic ulcer, where active hæmorrhage is present at the moment, but where there is no history of antecedent hæmorrhage—i.e., *a first hæmorrhage is taking place.*
4. The relation of surgery to cases of indubitable chronic ulcer where active hæmorrhage is in progress and where there is a history of one or more antecedent hæmorrhages—i.e., *a second, third, or even later hæmorrhage is occurring.*
5. The necessity of operative surgery during active hæmorrhage or the desirability of its postponement until after bleeding has ceased.
6. The outline of treatment in cases of bleeding from chronic ulcer and the indications for immediate surgery.
7. The nature of surgery to be employed.
8. The results of the surgical treatment of bleeding chronic peptic ulcer.
9. The association of perforation and hæmorrhage from chronic peptic ulcer.
10. The hæmorrhage from anastomotic ulcer.

1. THE ROLE OF SURGERY AS A PROPHYLACTIC MEASURE

Is surgery to be urged merely as a prophylactic measure against a possible hæmorrhage, perhaps severe, in patients with a chronic peptic ulcer of the stomach or duodenum? The prevention of hæmorrhage has indeed often been lightheartedly adduced as a supposedly powerful argument in favour of early operation for peptic ulcer, but the correct answer to the above question must surely depend on such relevant considerations as: (*a*) the incidence of hæmorrhage, possibly severe, in patients with chronic peptic ulcer; (*b*) the risk to life with which the ulcer-hæmorrhage is fraught; (*c*) the prospective protection afforded by operation

against hæmorrhage; and (*d*) the prospective mortality of that particular surgical measure which seems to promise the highest degree of protection against future bleeding.

a. **The Incidence of Hæmorrhage.**—The figures available appear to show that about 10 per cent of all patients with chronic peptic ulcer suffer from hæmorrhage, while a history of hæmatemesis or melæna is obtainable in 20 to 25 per cent of the more severe type of ulcer which secures admission into private or public hospitals (Hurst, Moynihan, Balfour, Crohn and Manheim, Conybeare, etc.)[9].

b. **The Risk to Life from Ulcer-hæmorrhage.**—It is difficult to orientate oneself amidst the welter of apparently conflicting statistics relating to this problem; the diverse mortality of ulcer-hæmorrhage in various hospitals, even in different clinics in the same institution, and in the several experiences of physicians of renown, seems governed by some strange caprice. Much difference of opinion is found to exist as to the exact connotation of the term 'severe' in the case of ulcer-bleeding; whereas by some a hæmoglobin estimate* of as much as 50 per cent is regarded as justifying the inclusion of the case in that category, by others ulcer-hæmorrhage is regarded as 'severe' only when the hæmoglobin is reduced to 40 per cent and the red cells to 2,000,000; other observers, still more critical, apply the term 'severe' to those ulcer-hæmorrhages in which the hæmoglobin is under 20 per cent. With these multifarious criteria of the severity of hæmorrhage comparison of the results of treatment becomes difficult and unreliable; nevertheless the chances run by the possessor of a chronic peptic ulcer of succumbing to hæmorrhage from that ulcer are not likely to be greater than 1 in 80, and no worse than 2·5 per cent if we reckon with only those ulcer patients the severity of whose condition secures their admission into hospital; the risk will vary with the length of history and the sex of the sufferer. However, any decision in favour of surgery in the treatment of chronic peptic ulcer is not likely to be attained merely on grounds of prophylaxis against hæmorrhage.

In the case of gastric ulcer, mechanical deformity, chronicity, severity of pain, incapacity for work, and the menace of malignancy will prove the determining factors. I am no ardent or precipitate operator in cases of duodenal ulcer, at any rate in those who are young, regarding as indications for surgery stenosis, perforation, gross hæmorrhage, the existence of a large crater, duration of symptoms, and an incapacity for work. The operation which, in my opinion, gives the greatest promise of immunity from hæmorrhage in duodenal ulcer is a resection, or where an ulcer is non-resectable some type of exclusion, preferably Finsterer's so-called 'resection-for-exclusion'; yet it seems difficult to press an operation of some magnitude merely as a prophylactic against a problematic hæmorrhage (*see below*).

c. **The Prospective Protection Afforded by Operation against Hæmorrhage.**—To such patients as seek from surgery protection against hæmorrhage it must be admitted that *there is no type of operation which will give absolute assurance*; Hurst[9] has even recorded that, in a certain series of 26 cases admitted to New Lodge Clinic for ulcer-hæmorrhage, in 11 operation had already been performed, and indeed 4 of these cases had never bled previously to surgical intervention.

Removal of the inflamed area certainly does seem to afford most protection against hæmorrhage, and this protection is likely to be greatest in cases of gastric ulcer;

* The estimation of blood-volume may be more valuable than the hæmoglobin-reading.

yet I have known a subsequent hæmorrhage from a fresh ulcer of the stomach to occur even after gastrectomy, and on two occasions I have met with hæmorrhage in connexion with a carcinoma of the stomach arising in organs which had four or five years before been subjected to gastrectomy for ulcer! In the cases of duodenal ulcer I have found even gastroduodenal resection to be followed by hæmorrhage from several months to several years after operation in patients who had never bled before; this has been my experience *in three cases where the duodenum and a considerable portion of the stomach had been resected and once when a resection-exclusion had been performed.* Such hæmorrhages may have come from anastomotic ulcers, which, although these do not succeed gastrectomy with that frequency wherewith they follow gastrojejunostomy, nevertheless do on occasion alarm.

Although a resection-operation may promise the most protection against bleeding, its possibility is contingent on the accessibility of the lesion and on the extent of the inflammatory process; thus it is said that in only 22 per cent of the hæmorrhagic duodenal ulcers in the Mayo Clinic series was removal possible (Eusterman and Balfour).[10] *The degree of protection, however, afforded by indirect operation against the hæmorrhage of chronic duodenal ulcer appears to be not inconsiderable,** despite the publication of cases which would seem to cast doubt on the truth of this statement; and the surgeon will be wise to put 'safety first' in respect of those patients for whom, by reason of diverse local or general causes, prospective excision occasions doubt and anxiety in the mind of the operator.

d. **The Prospective Mortality of an Adequate Operation to Prevent Hæmorrhage from a Peptic Ulcer.**—This will vary with the nature of the procedure envisaged, with the experience, skill, and judgement of the surgeon, and with the general condition of the patient. In the most experienced and competent hands an operation of resection or resection-for-exclusion carries nowadays a mortality of little more than 3 per cent, but this represents the acme of surgical skill and experience. Yet this figure is at least as great as, and may be greater than, the risk run by the possessor of a peptic ulcer of a death from hæmorrhage.

An operation undertaken solely on grounds of prophylaxis against bleeding is therefore to be discountenanced.

2. NON-BLEEDING CASES WITH A HISTORY OF ONE OR MORE HÆMORRHAGES

Should a history of one or more previous hæmorrhages cogently indicate surgical intervention in the treatment of non-bleeding peptic ulcer as a curative measure and as a prophylaxis against further bleeding?

Every case must be considered on its own merits. Physicians (Hurst,[9] Ryle,[11] etc.) have rightly complained that hæmorrhage not infrequently follows operation for ulcer, not only in patients who have already bled, but also occasionally in those who have never before suffered from hæmatemesis or melæna. This reproach to surgery may of course be due to the particular operative technique employed, since no direct attack may have been made on the ulcer itself. Hæmatemesis after surgery is encountered largely in cases of chronic duodenal ulcer, yet despite my trust that excision of the duodenal ulcer or some form of exclusion would be found to confer

* The ligature of arteries in the vicinity of the ulcer will still further improve the prospective protection of indirect operation.

upon those operated a complete immunity from future hæmorrhage, this hope has not been confirmed by further experience.

Disregarding the praiseworthy caution of English physicians, Eusterman and Balfour[10] believe that the *possibility of serious consequences from subsequent bleeding in cases in which no operation is performed is greater than the risk of operation and of its failure to protect against further hæmorrhages.*

Even if no circumstances are attendant converting the patient into a 'bad surgical risk' and thereby demanding the very utmost caution and judgement, I should not consider that a mere history of a single hæmorrhage in a patient known to have a chronic peptic ulcer cogently indicates the advisability of surgery, but every case is to be considered on its own merits, and any final determination to operate will probably rest upon the degree of ill-health and the inability to earn a livelihood on the part of the patient.

3. CASES PRESENTING A FIRST HÆMORRHAGE

Should a first active hæmorrhage from an indubitable chronic peptic ulcer be treated by surgery or not?

There are no hard-and-fast rules governing the treatment of such a patient; each case must be considered on its own merits. A policy of 'armed expectancy' should be adopted and the general outline of treatment and the indications for surgery should be adhered to (*see below*).

It should be remembered that according to some statistics 60 per cent of fatal hæmorrhages are first hæmorrhages (Allen and Benedict,[13] and Tidy[12]).

4. CASES PRESENTING A SECOND OR LATER HÆMORRHAGE

Does a history of one, two, or more hæmorrhages strengthen the case for surgery in the presence of active hæmorrhage from a known chronic ulcer (i.e., a second or third hæmorrhage)?

Although Allen and Benedict[13] say that multiplicity of hæmorrhage does not increase the gravity of the prognosis, yet only 20 per cent of their group of cases remained free from a recurrence of symptoms for five years, and recurrence almost always assumes the form of a further hæmorrhage, and in more than 50 per cent a return of the bleeding occurs within two years (Jordan and Kiefer).[14]

A history of antecedent recurrent hæmorrhage, the presence of active bleeding, and this statistical evidence of a prospective return of the catastrophe should call for immediate consultation between physician and surgeon; the watchword should be 'on the alert', and even despite the fact that subsequent hæmorrhage has been known to follow operation the bias of consultative opinion will surely be towards surgical intervention, and the latter should be of a very radical character. The existence of the active hæmorrhage will demand treatment based upon the opinions expressed in the following sections.

5. THE QUESTION OF OPERATING DURING ACTIVE BLEEDING OR AFTER ITS CESSATION

Does active hæmorrhage from a chronic peptic ulcer, whose existence is beyond cavil, require surgical treatment during the bleeding, or is surgery best practised after the bleeding has ceased?

The unexpected supervention of bleeding from a chronic peptic ulcer during an operation undertaken upon grounds other than the prevention of bleeding, fortunately imposes no difficult decision on the surgeon as to the time to operate for this complication, yet in the absence of immediate resuscitatory measures might impart a momentary anxiety as to the result (*Fig.* 298). More controversial is the question at the beginning of this section. Some physicians confess their inability to formulate an exact prognosis in cases of ulcer-hæmorrhage, while others appear to be gifted with a remarkable prescience in this respect. Less certain claims are made by Bolton[15] and by Conybeare,[16] the former affirming that after the seventh day the prognosis should be good, the latter remarking that it is " usually safe to give a good prognosis at any rate as regards immediate risk if four or five days have elapsed without recurrence." It is to be remembered, however, that *in* 40 *per cent of the fatal cases death takes place within three days and in* 25 *per cent on the third day itself* (*see below*). The mortality of cases of hæmatemesis from chronic ulcer of the stomach or duodenum treated medically at the Middlesex Hospital[17] from 1924 to 1933 inclusive in which a second large hæmorrhage took place was no less than 78 per cent, and with each successive bleeding the death-rate became higher. Confirmation of the dangers of recurrent ulcer-hæmorrhage are to be found in Chiesman's paper[18] based on the St. Thomas's Hospital figures from 1925 to 1931; in those patients in whom the hæmorrhage continued or recurred within twenty-four hours of the commencement of treatment there was a mortality-rate of 74 per cent.

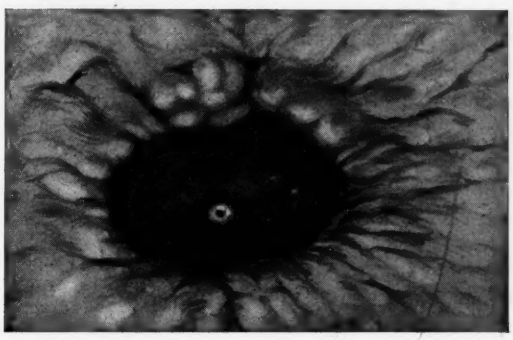


FIG. 298.—Portion of stomach from a patient of 70 submitted to partial gastrectomy for chronic ulcer; during the operation a considerable hæmorrhage occurred, of a severity sufficient to occasion alarm to those taking part in the operation. The opening in a branch of the left gastric artery is seen in the floor of the ulcer. The woman made a good recovery.

It is well known that the ' hæmorrhage-period ' in cases of bleeding chronic ulcer usually lasts for several days, and that it is the rapid *recurrence of bleeding which occasions anxiety and which may prove fatal.* Tixier and Clavel,[19] analysing the deaths from ulcer-hæmorrhage in their series, found that in 40 per cent the fatal termination was reached within three days, and that in 25 per cent death occurred on the third day itself. For these authors, as for Finsterer,[20] *the third day is the critical day.* The statistical inquiry of Tixier and Clavel[19] into the survival period of *those cases of chronic ulcer-hæmorrhage which proved fatal,* and into the prognostic value of the so-called ' hæmorrhage-rhythm ' may be summarized thus :—

a. The extreme gravity of those cases which bleed *on the first two consecutive days.*

b. The gravity of those cases which despite a free interval on the second day *are still bleeding on the third day*; the cases which are bleeding on the third day, even after a temporary cessation of the hæmorrhage, have an 80 per cent chance of dying within the succeeding forty-eight hours, i.e., *on the fourth or fifth day.*

c. Patients who do *not* bleed on the second and third day do not tend to bleed on the fourth day; of these cases 80 per cent will survive more than eight days

and 60 per cent live fourteen days or more, before death occurs from further hæmorrhage or the results of hæmorrhage.

In this last group of cases the general condition of the patients may improve sufficiently to justify even a complex type of operative surgery.

6. SUGGESTED OUTLINE OF TREATMENT AND INDICATIONS FOR SURGERY IN CASES OF HÆMATEMESIS

1. In every case of hæmatemesis or melæna, whatever the cause, immediate steps should be taken to organize donors from amongst the relatives and friends, so that the certainty of even half a gallon of blood of the same or a suitable group can be relied upon, should necessity arise. *It is impossible to foretell what may happen in cases of hæmatemesis.*

2. In every patient in whom bleeding is more than slight—i.e., a pulse-rate of 100 or more and a hæmoglobin estimate of, say, 50 per cent*—a *drip-transfusion* should be commenced straightway. A pulse-rate which remains over 100 indicates a great loss of blood and a risk for any prospective surgery; a patient with a hæmoglobin estimate of only 50 per cent* is in a relatively poor state to stand a resection, should such be deemed necessary at the time of operation. The need for drip-transfusion for such cases is manifest.

3. It is desirable that every case of hæmatemesis should be *transferred to a fully organized and equipped institution*, and if there is a possibility of the hæmorrhage originating from a gastric or duodenal ulcer the necessity for immediate transference is the more imperative. The exsanguinated patient can be removed with the drip-transfusion running when this seems indicated.

The objection has been raised by internists that grave cases of gastro-intestinal bleeding should never be moved, that the vast majority of cases of hæmatemesis seen in hospital should never have been sent for admission, and that the patients have been transferred thither through mistaken judgement on the part of their medical adviser, although in certain instances bad home conditions may have indicated the step. The employment of drip-transfusion and the results thereof during transportation impose the necessity of reconsidering this enjoinment. Patients have been transferred to me in London by ambulance and even in a guard's van (!), with the drip-transfusion running, from Hertfordshire, from southern Sussex, from Northamptonshire, Bedfordshire, Berkshire, Buckinghamshire, and other distant districts, and despite a journey of, for example, 80 miles, have suffered no set-back on the road. One patient, bleeding from an ulcer, with a hæmoglobin estimate of only 20 per cent on departure from Sussex, arrived in London with a better blood-picture as a result of the continuous transfusion than when he started on his long journey. The objections raised on the score of the grave danger of transport may thus be hotly contested in the light of certain experiences.

If transportation is decided upon, it should be undertaken early; any further complication, such as a subsequent perforation, etc., would preclude removal, especially over a distance of any magnitude.

4. Early consultation between physician and surgeon.

Continuous Drip-Blood-Transfusion.—It was my not infrequent experience in the past to encounter recurrent, sometimes almost immediately recurrent,

* The estimation of blood-volume may be more valuable than the hæmoglobin-reading.

ulcer-hæmorrhage after transfusions administered in the manner usual in former years either to combat anæmia consequent on gastro-duodenal bleeding, or employed as a method of pre-operative therapy. Bolton, however, regards the danger of recurrent bleeding consequent on the rise of blood-pressure due to transfusion as not great, but counsels the employment of two transfusions of blood, each of 250 c.c., at an interval of two hours.

Experience has shown that the customary transfusion of a pint (568 c.c.) is woefully inadequate in severely anæmic adults. My colleagues, H. H. Marriott and Alan Kekwick,[21] who have done so much to promote the practice of blood-drip-transfusion, point out that in the average adult a pint of blood is only equivalent to 10 per cent of the total amount of normal hæmoglobin and can only augment the total percentage by this amount; they have demonstrated that when transfusions of "adequate magnitude are practised the improvement in the patient is quantitatively commensurate". If large quantities of blood are to be administered, the necessity for slower administration is obvious, lest dangerous overloading of the circulatory system result. A selective retention of only the corpuscles without any increase in the plasma is found to occur if the transfusion is sufficiently slow.

Marriott and Kekwick, who are responsible for the technique of the blood-drip practised at the Middlesex Hospital, *aim at raising the hæmoglobin percentage by ten every four hours*. In non-bleeding patients, this represents a rate of introduction of *forty drops a minute*; but in bleeding patients a much more rapid pace may be necessary.

In those who are the subject of cardiovascular or respiratory disease and in the debilitated, it has been found safer to raise the hæmoglobin in stages by 30 per cent at a time; an interval of three or four days should preferably be left between each stage.

Drawbacks of the Drip-transfusion.—There is one danger to be foreseen from continuous drip-transfusion; its very success in at least temporarily arresting hæmorrhage may lead to vexatious delay and to ill-judged postponement of obviously indicated operation, until a time when the patient is worn out by the hope that is deferred, his tissues poisoned by morphia, his biochemistry altered by the starvation enjoined for the arrest of the bleeding, and his cough-reflex abolished by hypnosis; by then all is ready for an impending low-grade pneumonia, which will carry him off. When surgery is finally demanded *en dernier ressort*, it must occasion little wonder that fatality ensues.

Indications for Surgery.—

1. *Immediate operation* is indicated and may on occasion be practicable in cases of *terrific bleeding* (hémorragie foudroyante) where it is obvious that some large vessel has been eroded. Some of these patients, however, are already beyond mortal aid before surgical interference can be even contemplated; twice I have seen the hepatic artery eroded by a penetrating duodenal ulcer, and I have on at least half a dozen occasions encountered fatal hæmorrhage from ulceration into the splenic or some big artery on the posterior wall of the abdomen. It is, however, only too true that in many, even in most, of these cases the final fulminating hæmorrhage has been preceded by minor bleedings, for the arrest of which the employment of surgery has been neglected. If, however, drip-transfusion is already in progress, pint after pint of blood can be very rapidly run into the patient before, during, and after the operation undertaken to control the cataclysm, as shown by the following case.

E. F. had recently been admitted into a medical ward, and for his aid a blood-drip-transfusion had been instituted; after several days, during which the patient continued to bleed, as was shown by the hæmoglobin estimations, he vomited a large quantity of blood and blood poured from the rectum; he became pulseless and to all appearances dead.

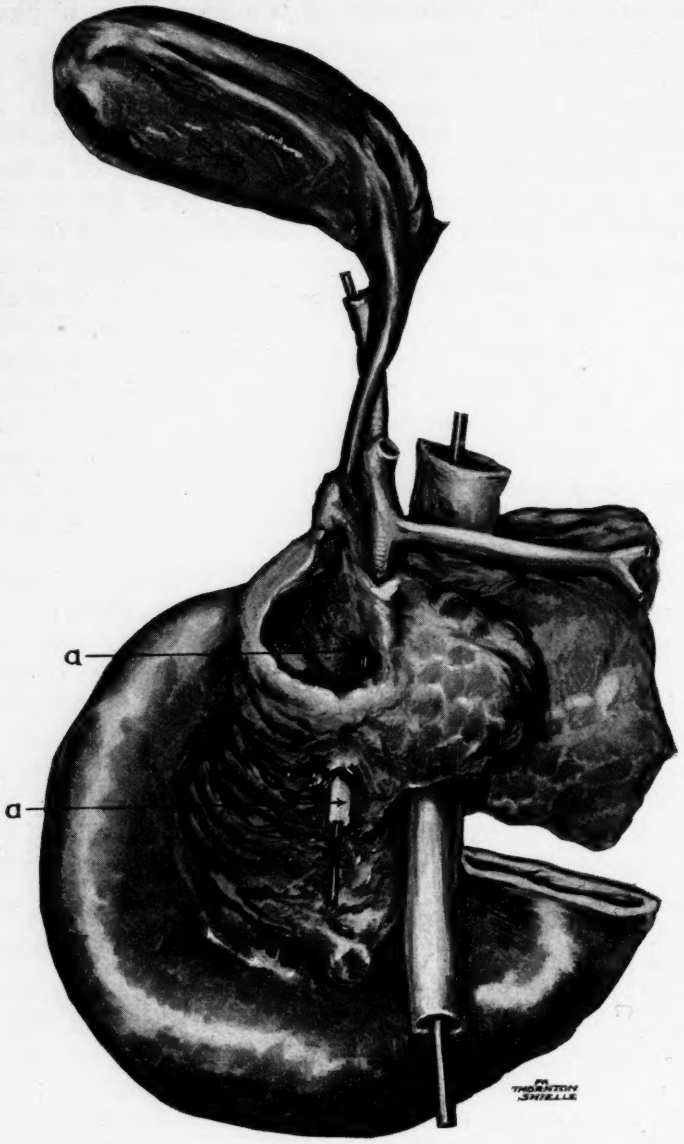


FIG. 299.—Post-mortem specimen of a chronic callous ulcer of the duodenum, which had bled for several days, before the fulminating hæmorrhage for the arrest of which late surgery was essayed. The gastroduodenal artery was found at operation to have been eroded. Death from pneumonia occurred two days later. *a*, Gastro-duodenal artery.

The house-physician, who happened to be in the ward and fortunately had a supply of blood at hand, rapidly turned on the blood-drip to its fastest rate and injected adrenaline into the heart; the patient rallied, was transported to the operating theatre, and his abdomen opened under local anæsthesia within half an hour of the catastrophe. Although the man before this sudden catastrophic bleeding had been a quiet, docile patient, the crisis appeared to have

induced an almost maniacal condition, and it was necessary to supplement the regional and splanchnic novocain infiltration with a prolonged gas and oxygen administration. A large posterior ulcer of the duodenum was found, and from its floor arterial blood spurted over my shoulder! The hæmorrhage was arrested; the gastroduodenal artery had been eroded at at least three points. The patient was returned to bed with a pulse under 100, but unfortunately died of a bilateral basal pneumonia two days later; at the autopsy the artery was found to have been successfully obliterated by the mattress sutures inserted (*Fig.* 299).

It was calculated that about 11 pints of blood had been lost by this patient before and during operation, and that that amount was administered by way of replacement by continuous drip-blood-transfusion.

2. Immediate operation is required in rare cases of concomitant hæmorrhage and perforation (*see below*).

3. Early operation is necessary in those ulcer-hæmorrhages in which *drip-transfusion is failing to control the hæmoglobin*—i.e., moderate bleeding must be continuing. The 'drip' should continue to run during and after the operation.

4. One should preferably operate as soon as the hæmoglobin has reached 60 per cent, with the 'drip' still running, in :—

a. Cases in which a recent radiograph has shown a large penetrating ulcer, whether the bleeding is slight or severe, and in spite of a short history.

b. Cases with long and definite ulcer history, whatever the degree of bleeding; the ulcer will be fibrotic and there will be ulceration into a definite vessel.

c. Cases of pyloric or duodenal stenosis, whether the bleeding is slight or severe.

d. Certain cases of mid-gastric narrowing.

e. Cases of a second hæmorrhage within a year, where there is a probable ulcer history. If the second hæmorrhage has followed soon after the first, the indications are even more cogent.

f. Cases of severe bleeding when ulcer cannot be excluded; these want the most careful consideration and caution.

In all these clinical types delay in operating may be fraught with grave peril. *Every case, however, must be considered on its own merits;* there can be no hard-and-fast rule. *Antecedent disease and intercurrent illness, the previous habits of the patient, his physical conformation, and all that constitutes the sufferer a 'good or bad surgical risk' must be weighed carefully; the personal courage of the patient as well as of the operator, the environment of the case, and the technical skill of the surgeon* are all factors which not only should influence the physician and surgeon in arriving at a decision as to the desirability of surgery, but may also dictate the appropriate technique when the abdomen has been opened.

7. NATURE OF THE SURGERY EMPLOYED

I am most anxious to protest *that the treatment of ulcer-hæmorrhage is not synonymous with partial gastrectomy.* There is no one technique appropriate to every case for which operation has been judged necessary; *the object of surgery is to arrest hæmorrhage,* and I have at times availed myself of such varied surgical measures as gastrotomy or duodenotomy with ligature of the bleeding vessel or vessels from the mucous membrane aspect (*Fig.* 300); pyloric occlusion and gastrojejunostomy; cautery or diathermy of the ulcer and gastrojejunostomy; sleeve-resection; gastrectomy, local or partial (*Figs.* 301–304); gastroduodenal

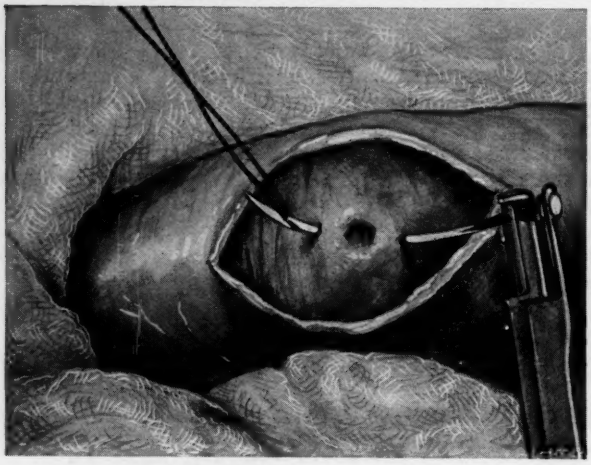


FIG. 300.—Successful duodenotomy for severe hæmorrhage from a callous ulcer on the posterior wall of the duodenum. The employment of a heavy needle of the Bonney-Reverdin type has sometimes been found useful.

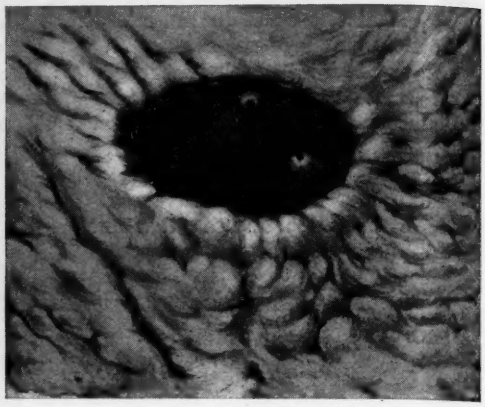


FIG. 301.—A local excision of a bleeding ulcer of the lesser curvature: two openings into a large branch of the left gastric artery can be seen in the floor of the ulcer. The patient was operated on during the first forty-eight hours of recurrent severe hæmorrhage and made a good recovery.

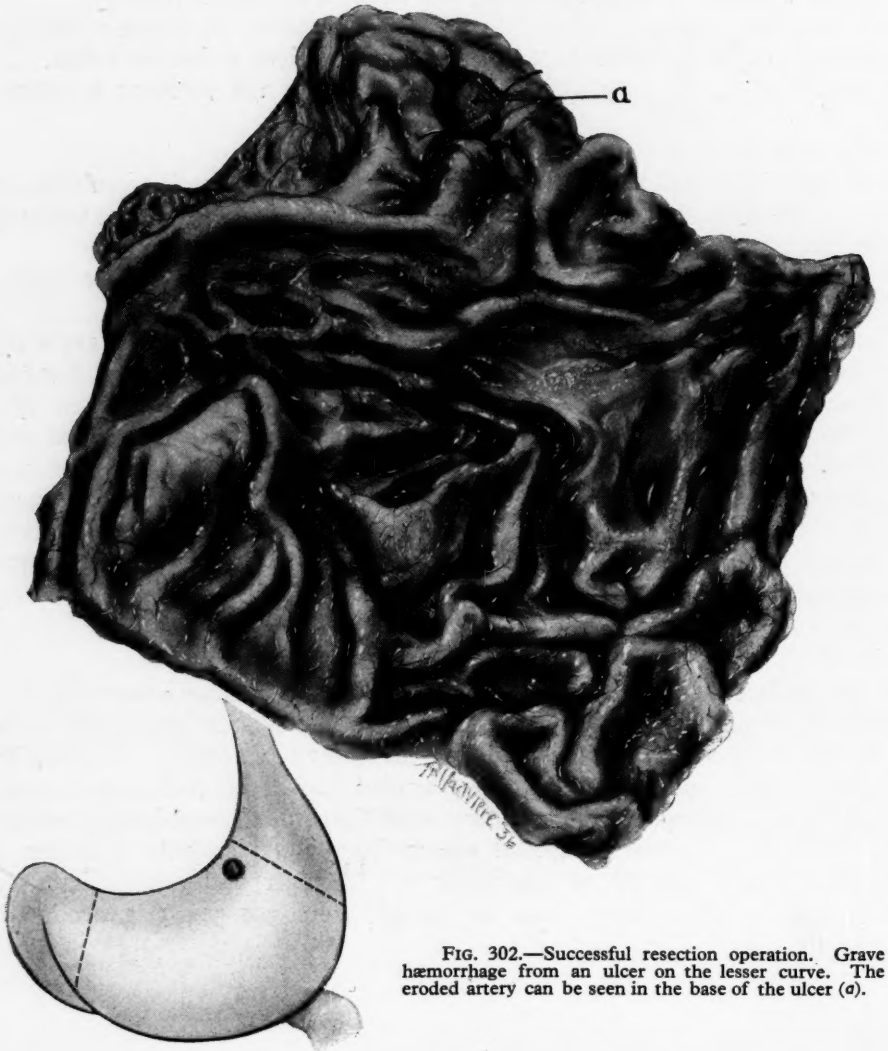


FIG. 302.—Successful resection operation. Grave hæmorrhage from an ulcer on the lesser curve. The eroded artery can be seen in the base of the ulcer (*a*).

FIG. 303.—Successful resection of the stomach for acute hæmorrhage from a chronic ulcer. The patient was admitted with 28 per cent hæmoglobin, having been bleeding for 12 hours. Continuous blood-drip for 24 hours, followed by operation. The arrow (a) shows an arterial branch of the left gastric artery in relief; three openings into the artery present.

FIG. 304.—Successful gastrectomy for bleeding chronic ulcer of the lesser curvature of the stomach; the opening (a) can be seen in a branch of the coronary artery of considerable calibre in the base of the ulcer.

resection* (*Fig.* 305); Finsterer's resection-for-exclusion; excision of duodenal ulcer with some form of plastic operation of the pylorus; and jejunostomy.

The ligation of the gastroduodenal artery (*Figs.* 306–309) in continuity in cases of bleeding duodenal ulcer has been found a useful adjunct to such indirect operative attack as pyloric occlusion and gastrojejunostomy, but in the case of callous duodenal ulcer with much surrounding œdema or infiltration the exposure and control of the vessel by ligature may be difficult; it is simpler and more useful in prophylactic surgery.

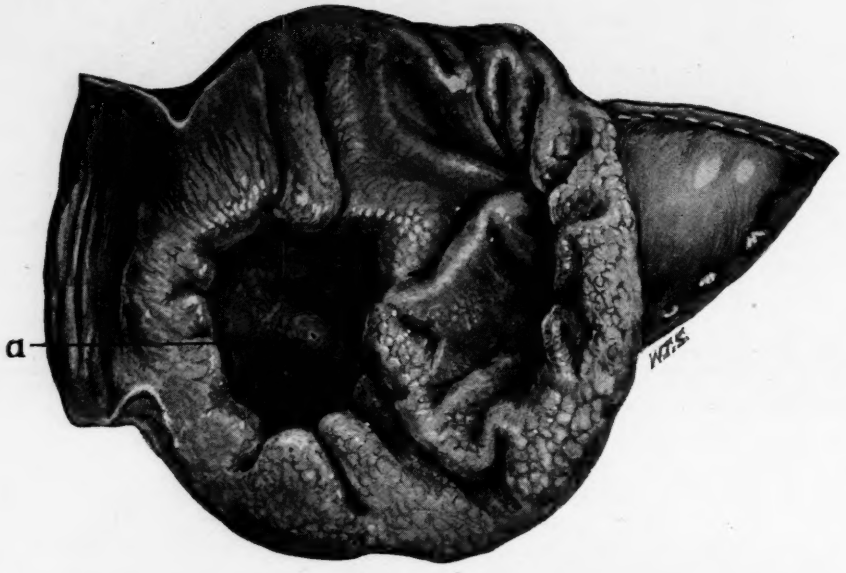


FIG. 305.—Successful gastroduodenal resection for a bleeding pyloric ulcer—operation in first twenty-four hours. (*a*) Opening into eroded vessel.

In the case of bleeding anastomotic ulcer I have practised complex and complicated resections (*Fig.* 310), and I have also dealt with a jejunal ulcer by an approach through the stomach wall.† (*Fig.* 311.)

Despite the greater uncertainty of indirect operation as a means of securing hæmostasis in bleeding duodenal ulcer, nevertheless some of *my greatest successes have followed a mere gastrojejunostomy with pyloric occlusion.*

Apart from a complicating hæmorrhage the operation of jejunostomy may play a useful part in the healing of a large and inaccessible gastric ulcer, and various writers have written enthusiastically of it (Hillman,[22] Kennedy,[23] etc.), but as a means of controlling bleeding I believe that it is better avoided save in some very desperate venture. Nevertheless, by utilizing this operation I have on three occasions indubitably saved the life of patients with severe hæmorrhage: two were elderly females, each with a bleeding ulcer very high up on the lesser curve and

* My colleague, Mr. R. Vaughan Hudson, has had several successful gastroduodenal resections for severe recurrent hæmorrhage taking place at the time of operation from a posterior duodenal ulcer.

† My colleague, Mr. Eric Riches, has also recently operated successfully for a hæmorrhage from an anastomotic ulcer by transgastric approach.

on the posterior wall; the ulcer was cauterized and a temporary jejunostomy performed; both are well six and seven years later with non-recurrence of symptoms. The third case was a male (A.P., aged 45) who had a serious bleeding after a sub-total gastrectomy for recurrent anastomotic ulcer consequent on operation for an initial duodenal ulcer. Severe hæmorrhage determined renewed surgical

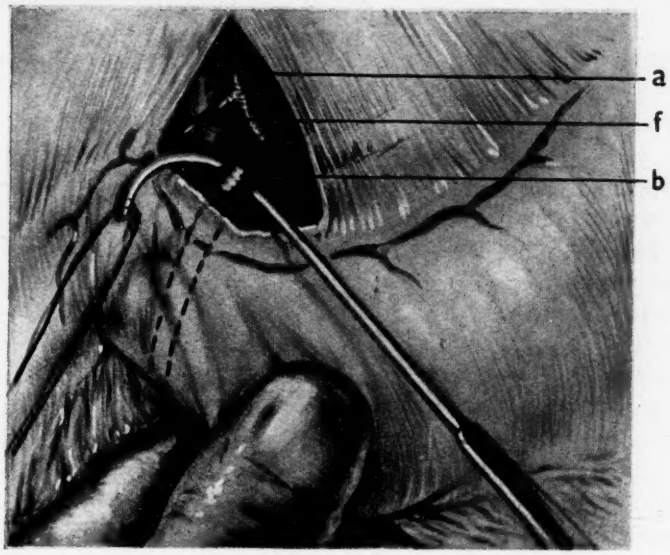
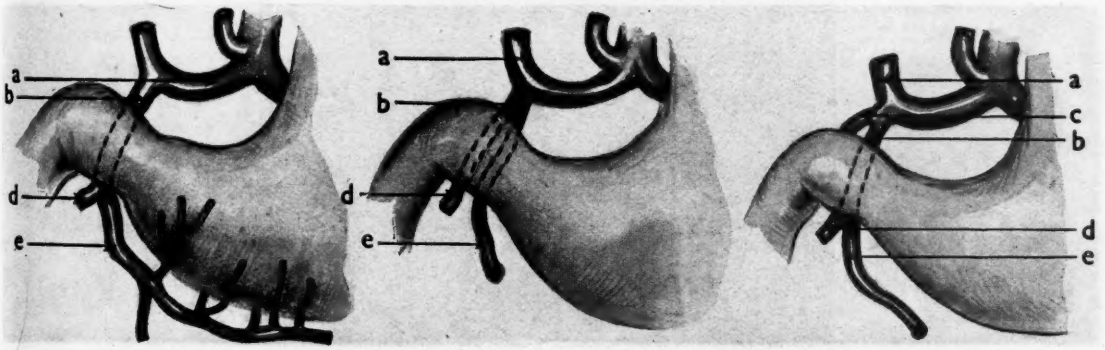


FIG. 306.—Ligature of the gastroduodenal artery in continuity for bleeding duodenal ulcer. a, Hepatic artery; b, Gastroduodenal artery; f, Pyloric artery.



FIGS. 307–309.—Demonstrating the variations of origin of the branches of the gastroduodenal artery, and indicating the possibilities of failure to identify the artery that is the source of severe bleeding, when the vessel is tied in continuity from outside the gastroduodenal wall. a, Hepatic artery; b, Gastroduodenal artery; c, Supra-duodenal artery; d, Superior pancreatico-duodenal artery; e, Right gastro-epiploic artery. (*Modified from Paitre, Lacaze, and Dupret.*)

interference, and a jejunostomy was performed; at the anastomosis and extending right up to the cardia there was found a large ulcer inaccessible to surgical attack. Despite the absence of almost the whole of his stomach, the man has nearly doubled his weight!

The time-factor is of greater importance than surgical technique, and perhaps almost as valuable even as surgical judgement; *early operation is as important for success in hæmorrhage as it is in perforation.* The blood-drip may have widened

the scope of resection and has perhaps extended the period of time during which incursion may give good promise of success, but if surgery is required, Finsterer's[30] 'first forty-eight hours' is still the time-limit within which to operate. In every paper Finsterer emphasizes the importance of early operation, for when surgery

FIG. 310.—Specimen of a successful resection for a bleeding jejunal ulcer. Gross hæmorrhage had been present for twenty-four hours.

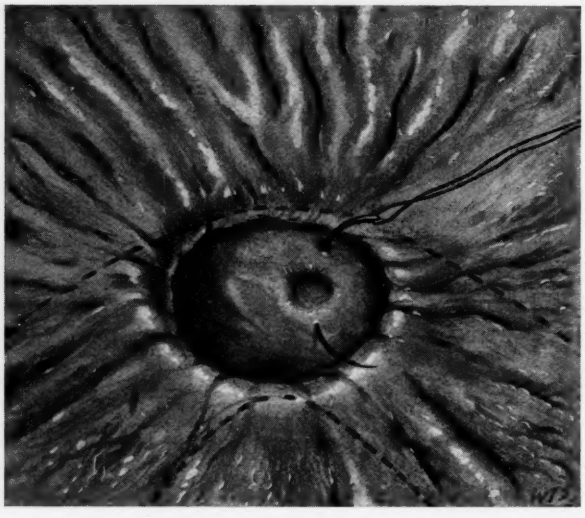


FIG. 311.—Successful case of operation for hæmorrhage from a jejunal ulcer; the jejunal ulcer has been exposed through an incision in the stomach. Bleeding was controlled by mattress sutures introduced by means of the Moynihan curve of needle. The jejunum is indicated by dotted lines.

was utilized in the first forty-eight hours there were only 3 deaths in his series of 59 cases—i.e., a mortality of 5 per cent; in view of the bad results of late operation he does not advise surgery if there is any possibility that hæmorrhage has ceased. According to the Viennese surgeon the definite arrest of hæmorrhage cannot repair

the damage to the parenchymatous organs caused by prolonged anæmia, although he admits that perhaps repeated transfusion might prevent death.

Ian J. Wood[24] points out that as a result of low hæmoglobin and impaired circulation every organ is inadequately supplied with oxygen, with consequent impairment of function; a widespread œdema of the tissue results and is especially seen in the lungs; Wright-Smith has also drawn attention to the widespread œdema at autopsy.

Anæsthesia.—The importance of operating under local anæsthesia in these cases cannot be over-estimated; if the operation cannot be completed under regional and splanchnic anæsthesia, the latter should be supplemented by a short gas-and-oxygen inhalation.

In the operation of gastrectomy under ordinary conditions, I am not convinced of any superlative advantage to the patient of an operation performed entirely under local and splanchnic anæsthesia, to which a closed method of gas-and-oxygen inhalation may have to be added. Despite a trial of this technique for nearly a year during two separate periods in the past decade and a half, I have a definite preference for local and splanchnic nerve-block with a very, very light anæsthesia of ether and chloroform, yet in a 'crisis-gastrectomy' for a desperately ill patient the efficiency of the nerve-block and the exclusion of general narcosis may determine the success of the surgical undertaking. The strengths of the anæsthetic solutions employed should of course be reduced suitably.

Morphia.—There is undoubtedly a danger of the administration of too much morphia in these cases of ulcer-hæmorrhage. The patients may have already been heavily 'morphinized' in the early stages of the hæmorrhage, and where an operation under regional anæsthesia is envisaged there may be a tendency to overdose; more than gr. $\frac{1}{4}$ for a man or gr. $\frac{1}{6}$ for a woman should be avoided*; the danger of lung complications in those heavily dosed with morphia is a very real menace. The words of Chevalier Jackson[25] are perhaps apposite in relation to the thoracic complications of upper abdominal surgery: "The cough-reflex is the watch-dog of the lungs. It seems strange that medical men should drug the watch-dog asleep when his efforts are most needed. Morphia and heroin have indirectly killed thousands by the abolition of the cough-reflex for every death that has resulted from their direct toxicity".

8. RESULTS OF THE SURGICAL TREATMENT OF BLEEDING CHRONIC PEPTIC ULCER

The cases in which I have dealt with urgent hæmorrhage from chronic ulcer of the stomach or duodenum by surgical attack may be considered under four different periods of time; in all only 63 interventions have been made to arrest the bleeding of chronic ulcer, and 12 patients have succumbed. The active periods of 1919 to 1924 and 1933 to 1936 are those of most interest.

a. The period 1919 *to* 1924, when I was still profoundly influenced by the dramatic results of blood-transfusion to which I had been introduced during the War and of which I had had considerable experience in France and Flanders.

* Where time permits, it may be well tentatively to probe the reaction of the patient to a small dose of scopolamine, and if this be favourable its exhibition with morphia will facilitate operation under local anæsthesia. If an unfavourable reaction be encountered, general narcosis will probably be required.

During this period of enthusiastic surgery for active ulcer-hæmorrhage 20 out of 22 cases recovered from operation—a mortality of 9 per cent. These cases were almost all early operations in the first day or two of the bleeding, and many were done in the first twenty-four hours.

A certain number of the patients were transfused, but transfusion arrangements were more difficult in those days, and not only had the surgeon often to pay the donors himself, but he was also sometimes set the difficult task of finding them! The fact that 20 patients survived out of 22 would appear to be largely due to early operation—9 per cent mortality; an appropriate choice of operation may also have played a part.

b. The period 1924 *to* 1926, during which operation was performed in only 10 cases of severe hæmorrhage from chronic gastric or duodenal ulcer, with 4 deaths, i.e., a mortality of 40 per cent. The high mortality-rate may have been due to the fact that many were dealt with in institutions remote from personal supervision, and the task was essayed without all the arrangements necessary for adequate and repeated transfusion. A spirit of self-criticism and a disinclination to operate 'à chaud' were thereby induced.

c. From 1926 *to* 1933 I made little use of surgery in the cases of hæmorrhage from peptic ulcer which I encountered, and of 43 cases of chronic ulcer-hæmorrhage which I saw in consultation during these years, operation was performed in only 10. Almost all of these cases were operated upon in the first forty-eight hours and 8 recovered; the 2 fatal cases were both patients who were operated upon after six days and seven days recurrent bleeding; in one a gastrectomy was performed, and in another a jejunostomy alone seemed possible.

Of the remaining 33 cases that were denied operation during this period almost all died; the appalling mortality in this particular series made me anxious again to deal with the problem by surgical attack. The patients seen at this time were largely in outlying hospitals and in private practice; there were no operations for active hæmatemesis at the Middlesex Hospital during this period, which corresponded with that from which the series of fatal ulcer-hæmorrhages at the Middlesex Hospital was obtained showing a 24 per cent mortality-rate (*see* p. 422). Transfusion was unfortunately little employed, apart from those cases actually subjected to surgery.

d. From 1933 *to* 1937 I have been again exploring surgery as a means of improving the results of ulcer-hæmorrhage, and our therapeutic armamentarium has also been recently reinforced by the introduction of the 'continuous intravenous blood-drip' by Marriott and Kekwick.

I have had the opportunity of dealing with two groups of cases of hæmatemesis during this period: (i) A personal series has been admitted directly under my care in hospital or in private practice; but (ii) I have also enjoyed the privilege of dealing with certain cases admitted into our Courtauld Research Ward at Middlesex Hospital under the care of my colleague, Dr. Izod Bennett, which after consultation have on occasion appeared to demand surgical assistance. At the risk of a charge of wearisome reiteration I would re-affirm the paramount importance of *the establishment of a diagnosis of chronic peptic ulcer beyond a doubt before any surgical intervention be contemplated.* Apart from gastroduodenal ulceration, an enormous and motley collection of pathological states may have hæmatemesis or melæna as a symptom, and the possibility of one of these as the cause of the cataclysmic menace to life must be most carefully excluded.

The various circumstances which constitute the patient a 'bad surgical risk' also require earnest consideration, and because of these and on account of uncertainty of diagnosis I have found that in point of fact *I operate upon only one-third of the cases of hæmatemesis admitted directly under my care or brought within my actual observation.*

During this recent period I have dealt with 22 cases, of whom 15 have been early cases, some being operated upon within twenty-four hours. By no means all of these have been transfused, yet only one has succumbed; death in this case was said to have been due to bronchopneumonia, probably related to the presence of some very septic teeth, the employment of a closed form of anæsthetic, and the too liberal administration of morphia.

Of the remaining 7 late cases, one died after gastroduodenal resection for a large penetrating duodenal ulcer, which had perforated and had been successfully sutured outside London eight days before recurrent hæmorrhage of severe character supervened; the almost uniformly fatal character of persistent and recurring hæmatemesis following on perforation will be referred to later. A resection was performed in this particular patient, who died a week later with nearly 100 per cent hæmoglobin and with no post-mortem findings in the peritoneum or in the chest to account for his demise! Probably parenchymatous changes in the solid abdominal organs, the presence of which in the late cases of hæmorrhage has been so strongly stressed by Finsterer,[30] may have produced the fatal result.

The second followed an attempt to rescue a patient who had bled for some time under medical treatment, who had been heavily morphinized, who apparently died of bleeding and yet was resurrected, but who finally succumbed from pneumonia (*see* p. 412). For the untoward result in these two cases surgery can hardly be blamed.

The third death was consequent on the sudden giving-way of the whole suture-line some days after a gastrectomy for a very high bleeding ulcer which had been transferred to me; the patient was overwhelmed by the sudden catastrophe and died in a few minutes. Surgery cannot be exculpated in this case, but possibly the devitalized condition of the tissues may have contributed to the fatal ending.

If the first and second fatalities mentioned above be excluded from the computation of 19 cases surgically dealt with, 2 died of operation—a mortality of 10·5 per cent.

OPERATIONS FOR ACTIVE HÆMORRHAGE FROM CHRONIC ULCER

PERIOD	OPERATIONS	RECOVERY	DEATHS	MORTALITY
				Per cent
A. 1919–1924	22	20	2	9·0
B. 1924–1926	10	6	4	40·0
C. 1926–1933	10	8	2	20·0
D. 1933–1937	22	18	4*	19·0
but 1933–1937 (amended)	20	18	2	10·0

* 2 of the 4 fatalities were hopeless cases.

The segregation of a group of cases of ulcer-hæmorrhage in a Research Ward at Middlesex Hospital, and the more frequent use of transfusion and especially drip-transfusion, have brought the *percentage of non-operative failures* down to a figure more flattering to medicine than the 24 per cent which was found to obtain in the series 1926–1933; and some of these fatalities *no* surgery could have saved.

9. HÆMATEMESIS AND PERFORATION

There are three groups of cases to which a brief reference must be made.

a. In a somewhat insignificant minority of ulcer-hæmorrhages there may be a *concomitant perforation*. The association is fortunately rare, and on the combined figures of Tixier,[19] Mondor,[26] and Elsworth Eliot[27] amounts to only 2 or 3 per cent. These two complications of peptic ulcer may occur simultaneously in a fashion unmistakable before operation, and perforation will demand, of course, urgent surgery; on the other hand, the twin nature of the catastrophe may be discovered only during the course of the procedure. The association of an active hæmorrhage will naturally call for some modification of the technique habitually employed in dealing with perforation of a peptic ulcer.

I have encountered more than my share of cases of this combination of catastrophe, since I have intervened for this syndrome four times in connexion with gastric ulceration and once for a bleeding and perforated duodenal ulcer; all five cases were dealt with by some form of resection, *with no mortality*. I have, however, dealt *unsuccessfully* with a perforated jejunal ulcer consequent upon a gastrectomy for duodenal ulcer; the jejunal ulcer was actively bleeding at the same time. In two other cases after an exploration, I found it impossible to do anything for a bleeding gastrojejunal ulcer, which had still further complicated the clinical picture by eroding the transverse colon.

b. Hæmorrhage from a peptic ulcer may precede perforation: the fatality of this sequence of complications is prodigious. In these cases the enfeebled condition of the patient from a hæmorrhage is liable to mask the ordinary clinical picture of a perforation, which may fail to be diagnosed; all the cases that I have seen have died; almost all were beyond surgery.

c. Finally, early hæmorrhage may complicate the progress of a successful operation for perforation. In my own experience the results have been calamitous, whether the bleeding has been attacked by surgical intervention or treated medically. These hæmorrhages are usually ushered in by an increased pulse-rate and some elevation of temperature; they occur as a rule from seven to twenty-one days after the initial emergency operation. The hæmorrhage may originate from the sutured ulcer itself, from some other ulcer in the stomach, or it may be a diffuse parenchymatous bleeding from the gastric wall. Despite the grave prognosis in this combination of complications, recovery has been known to occur* in patients in whom melæna of considerable degree has followed a successful suture of a perforation (Tixier and Labry[28]). In two cases of my own a diffuse parenchymatous

* My colleague, Mr. Eric Pearce Gould, had a male patient with a perforated gastric ulcer in whom the blood-count showed only 2,000,000 red cells and 40 per cent hæmoglobin, and who therefore had bled before operation. A somewhat eventful early convalescence was still further punctuated by a hæmatemesis a month after the perforation; thanks to drip-transfusion and gastrectomy, recovery took place. In this case, however, a month elapsed between the two catastrophic complications of the chronic ulcer.

hæmorrhagic condition of the gastric mucosa was found; both cases ended fatally despite surgery.

Is there any prophylactic measure against this most lethal combination of catastrophes? Tixier states that he knows no case where serious hæmorrhage has followed the resection of stomach or duodenum for a perforated ulcer, but resection can hardly be urged as a routine measure for perforation, although Alessandri[29] and certain other Continental surgeons speak well of it in early cases; an enormously increased mortality from perforated ulcer throughout the country would result if this operation were regarded as the appropriate form of surgery in every such case. Fortunately the catastrophic combination is unusual, if not rare.

Results of Operations for Hæmorrhage associated with a Perforation of Peptic Ulcer.—

a. Concomitant Hæmorrhage and Perforation.—

Condition	Number of Operations	Nature of Operation	Recovery	Death
1. Gastric perforation and hæmorrhage	4	Resection	4	–
2. Duodenal perforation and hæmorrhage	1	Resection	1	–
3. Hæmorrhage and perforation of anastomotic ulcer	2	Resection	1	1
4. Hæmorrhage and perforation of anastomotic ulcer into the colon	2	Exploration	–	2
Total	9		6	3

b. Cases of Severe Hæmorrhage followed by Perforation.—Of 3 operations performed all proved fatal; of the cases unopened all ended fatally.

c. Cases of Perforation Complicated by Subsequent Gross Hæmorrhage.—Five operations—all resections—with five deaths. Cases unopened—all died.

10. HÆMORRHAGE FROM AN ANASTOMOTIC ULCER

If an anastomotic ulcer is complicated by severe hæmorrhage, the surgical attitude should be that directed towards bleeding ulcer of the stomach or duodenum. Whereas the accounts penned by Continental authors produce the impression that hæmorrhage rarely characterizes peptic ulcer of the jejunum, the investigations of Hurst, based upon the material at New Lodge Clinic, demonstrate that practically 50 per cent of the anastomotic ulcers admitted have bled. Despite its severity, hæmorrhage did not prove fatal in any of the New Lodge Clinic cases, and in only 1 out of 22 autopsies on anastomotic ulcers in the Leeds series was bleeding the immediate cause of death. The reputed low mortality of this clinical complication of hæmorrhage and the anxieties attending operation should make one willing to *wait unless hæmorrhage be very severe*; Tixier and Clavel found that of 7 cases in

which a bleeding anastomotic ulcer was operated 'á chaud', 3 recovered and 4 died.

Amidst the anxieties of a complex artificial pathology, if urgent operation for an ulcer-hæmorrhage be required, the least possible should be done at this crisis-operation; hæmostasis alone is to be secured. I have dealt with severe bleeding from a jejunal ulcer with a fortunate result on two occasions by an approach through the stomach, and on two occasions I have successfully performed a resection operation, complicated though it proved to be. (*Figs.* 310, 311.)

CONCLUSION

Fortune appears to smile capriciously on physicians in their happy experience with bleeding peptic ulcer; and the incredulity of surgeons may even be lulled into belief by the oft-repeated statement that fatal cases of ulcer-hæmorrhage never occur in private practice and that a blood-transfusion has scarcely ever been required, much less enjoined, for this more highly-favoured class of sufferer; nevertheless, during the years 1924 to 1933 many of my own fatal cases were met with in this very group, whose future would appear to be so rosy.

The day will assuredly come when medical science will cure every ulcer of the stomach and duodenum with a certainty approximating to that wherewith it controls diabetes, pernicious anæmia, or certain of the tropical infections; but until that era ulcer-hæmorrhage, severe ulcer-hæmorrhage, will continue to occur and to recur, gravely menacing life, and perchance ending fatally. The problem of the bleeding peptic ulcer is certainly not one of surgery versus medicine, although without doubt there is a group of cases which operation alone can save. That a very large percentage of ulcer-hæmorrhages cease to bleed spontaneously or by reason of medical treatment is not denied; it is also freely admitted that the success following early operation might have attended an expectant line of treatment, but late surgical intervention consequent upon unsuccessful medical therapy is attended by a forbidding mortality: *therein lies the difficulty in decision as to treatment.*

I am merely pleading that the surgeon be not excluded from the consultation until that last desperate stage of ulcer-hæmorrhage. Supreme judgement on his part will be of more value to his patient than the acme of operative skill; indiscriminate operation cannot be too strongly condemned. Statistics may be valuable, but the surgeon no less than the physician will be sadly wanting in his art if he be influenced by these in the treatment of the individual; *every case is to be regarded as a special problem deserving of the most careful attention.*

The value of the continuous blood-drip transfusion is inestimable, and if in certain cases operation should appear probable, or possible, it is important to *remember that critical third day*, for Finsterer's[30] 'first forty-eight hours' is still the optimum period for surgical attack in the bleeding of chronic peptic ulcer.

The illustrations which adorn this paper are from the pen and brush of my friend W. Thornton Shields, to whom, as always, my most grateful thanks are due.

REFERENCES

[1] TIDY, E. LETHEBY, *Brit. Med. Jour.*, 1928, i, 583.
[2] GORDON-TAYLOR, G., *Lancet*, 1935, ii, 811.
[3] GORDON-TAYLOR, G., *Brit. Jour. Surg.*, 1930, xviii, 78.

[4] MEULENGRACHT E., *Lancet*, 1935, ii, 1222.
[5] CULLINAN, E. R., and PRICE, R. K., *St. Bart.'s Hosp. Rep.* 1932, 185.
[6] CHRISTENSEN, OLINE, *Brit. Med. Jour.*, 1934, i, 995, and *Ugeskr. f. Læger*, 1934, Jan. 4, 14.
[7] HUNTER, J. B., *Brit. Jour. Surg.*, 1928, xvi, 203.
[8] WALTON, Sir JAMES, *Brit. Med. Jour.*, 1935, i, 172.
[9] Quoted by HURST, A. F., and STEWART, M. J., *Gastric and Duodenal Ulcer*, 1929, 253. London.
[10] EUSTERMAN and BALFOUR, *Stomach and Duodenum*, 1935. London: W. B. Saunders.
[11] RYLE, JOHN, *Trans. Med. Soc. Lond.*, 1934, 246.
[12] TIDY, E. LETHEBY, *Brit. Med. Jour.*, 1936, i, 1146, and *Lancet*, 1935, ii, 1290.
[13] ALLEN, A. W., and BENEDICT, E. B., *Ann. of Surg.*, 1933, xcviii, 736.
[14] JORDAN, SARA M., and KIEFER, EVERETT D., *Jour. Amer. Med. Assoc.*, 1934, Dec. 29, 2004.
[15] BOLTON, CHAS., *Brit. Med. Jour.*, 1936, i, 222.
[16] CONYBEARE, J. J., *Lancet*, 1935, ii, 1017.
[17] Middlesex Hospital Series, quoted by GORDON-TAYLOR, *Proc. Roy. Soc. Med.*, 1934, xxvii, 1524.
[18] CHIESMAN, W. E., *Lancet*, 1932, ii, 722.
[19] TIXIER, L., and CLAVEL, C., *Les Grandes Hémorragies Gastro-duodénales*, 1933. Paris: Masson et Cie.
[20] FINSTERER, H., *Jour. de Chir.*, 1933, xlii, 673.
[21] MARRIOTT, H. L., and KEKWICK, A., *Lancet*, 1935, i, 977.
[22] HILLMAN, O. S., *Brit. Med. Jour.*, 1933, i, 221.
[23] KENNEDY, JOHN (of Melbourne), personal communication.
[24] WOOD, IAN J., *Brit. Med. Jour.*, 1936, ii, 115.
[25] JACKSON, CHEVALIER, quoted by GORDON-TAYLOR, *Lancet*, 1935, ii, 811.
[26] MONDOR, H., *Diagnostiques Abdominaux Urgents*, 1933, 2nd ed., 201. Paris: Masson et Cie.
[27] ELIOT, ELSWORTH, quoted by TIXIER and CLAVEL.
[28] TIXIER and LABRY, quoted by TIXIER and CLAVEL.
[29] ALESSANDRI, R., private communication.
[30] FINSTERER, H., *Lancet*, 1936, ii, 304.

CRITICAL REVIEW

THE SURGERY OF THE SYMPATHETIC NERVOUS SYSTEM

By J. R. LEARMONTH

SURGEON TO HIS MAJESTY THE KING IN SCOTLAND
REGIUS PROFESSOR OF SURGERY IN THE UNIVERSITY OF ABERDEEN

INTRODUCTION

One of the most arresting features of the history of the development of scientific knowledge is the number of instances in which major contributions have resulted from the observation and investigation of phenomena outside the original scope of a particular inquiry. The expansion of the surgery of the sympathetic system provides one example. It is true that sporadic operations on sympathetic nerves had been performed for epilepsy in the latter part of the nineteenth century; that in the first two decades of the twentieth Jonnesco employed carefully planned operations in an attempt to relieve the pain of angina pectoris; and that Leriche was aware of the temporary vasodilatation that follows periarterial sympathectomy: but the immediate impetus to the development of the surgery of the sympathetic nervous system came from the incidental observation of Royle[76] (1924) that after division of the sympathetic nerves to an extremity (in an endeavour to diminish spasticity of muscles) there occurred a notable increase in the flow of blood to the denervated parts. This direct evidence of the result of division of vasoconstrictor fibres was taken up, tested, and expanded to form the foundation upon which many accurately planned procedures have since been established.

To be well founded, an operation must be carried out in the light of exact anatomical and physiological knowledge. While much of the gross anatomy of the sympathetic system was already known before the rebirth of its surgery, the problems of the ward and of the operating theatre stimulated its further investigation; and one result has been the addition of a very considerable volume of information regarding the anatomical relationships of sympathetic nerves, their terminal distribution, and the methods of exposing them. Contributions of this kind have been made both by anatomists and by surgeons, and these will be noted in their appropriate sections. They have led both to extension and to limitation of surgical interference, and thus even in a comparatively brief period operations have been modified and remodified, or discarded and replaced by others, in attempts to narrow the objective. This process of anatomical refinement is by no means exhausted. For the present, one distinct limitation of the process may be noted: the absence of intraneural topography in the sympathetic nervous system precludes both the performance of physiologically selective neurectomies, and also the isolation, in the large trunks, of bundles destined for a particular distribution. As regards the physiology of the sympathetic system, the fundamental part played by British physiologists in its elucidation needs no emphasis.

The incursion of surgery has led to a substantial increase in knowledge, as a result of the physiological outlook of the majority of surgeons interested in this field. All over the world surgeons have been quick to avail themselves of the opportunities presented by sympathetic neurectomy for recording the results of their operations in physiological as well as in clinical terms. These results have been discussed in great detail by physiologists, physicians, and surgeons; and all have united in pooling experience in an attempt to adjust discrepancies and to establish facts. It would be unjust, though the opportunity has not passed unnoticed, to labour the contributions of surgeons to the physiology of the sympathetic nervous system in man (the 'hominal' physiology of Lord Moynihan); and that because the great neurophysiologists of the English school were always careful to avoid, and to warn others to avoid, the transference of findings obtained in one species of animal to similar processes in others. It is as unjust, and again the opportunity has not passed unnoticed, to comment unfavourably on operative procedures on the sympathetic system justified by available knowledge, but destined to be abandoned with the accumulation of experience and the critical and understanding appraisal of this by colleagues. The absence of mathematical precision in the results of a surgical procedure should lead not to its condemnation but to reservation of judgement. This lack of finality in both anatomical and physiological concepts is illustrated by the differing results obtained from sympathectomy by the same reliable observers in cases which are to all appearances clinically similar.

With regard to the final requirement in any diagnostic problem —the nature of the pathological process—it may be said at once that with rare exceptions* structural lesions have not been identified in any part of the peripheral sympathetic nervous system (Craig and Kernohan,[12] 1933) in conditions in which sympathetic neurectomy has been claimed to be of value. Obviously such failures to identify primary lesions represent gaps in the sum total of our knowledge of processes of disease, of which at least a proportion will be filled; and it would be wrong to deny to patients the benefit of operations, crude though these may be at present, on the ground that the condition which it is proposed to relieve—not necessarily to correct—is still imperfectly understood.

Since 'sympathectomy' is an indirect procedure, its results will depend, broadly, on three factors:—

1. The permanence of the interruption of nerve pathways; that is, the possibility of regeneration in the system, and of the regenerated fibres again establishing control in their territory of distribution. Experience at re-operation in cases where this possibility was present has shown (e.g., Telford,[85] 1935) that after properly planned and properly executed procedures, restoration of continuity is absent.

2. The presence of a local nervous apparatus, which is capable, either at once or after a period of adaptation, of restoring and maintaining normal physiological control. For example (Cannon, Lewis, and Britton,[9] 1927), it is known that animals may lead 'laboratory' lives after interruption of all the central connections of the whole sympathetic system; but on detailed examination local evidence of interruption of sympathetic pathways is readily forthcoming. Local

* Such as Dott's (Adamson and Aird,[2] 1932) cases of megacolon and megalo-ureters in which a chronic inflammatory process was present at least in contiguity to a possible causative factor.

autonomy is present to a greater degree in some systems (e.g., the alimentary) than in others (e.g., the peripheral vascular). This problem is of great complexity in man, because it is rare for operations on the sympathetic system to be performed on normal subjects. It is certain, however, that interruption of vasoconstrictor and sudomotor pathways cannot be compensated for by intrinsic nerve mechanisms.

3. The stage reached by the local pathological process for which sympathectomy is performed, and the rate of progress (if any) of this process (sympathectomy for pain excepted). This factor may be reduced to changes in the walls of living conduits and reservoirs which interfere with their function of transmitting their contents, and which are either degenerative or inflammatory in nature. It is by far the most important factor (Gask and Ross,[25] 1937), and although 'present condition' can often be accurately enough assessed by appropriate tests, the future behaviour of the pathological process may be difficult to compute, although as clinical experience increases, disappointments from operative interference become fewer.

At this stage it will be convenient to include certain generalizations regarding the technique of operations on the sympathetic nervous system. To date, the central pathways of the system have not been subjected to surgical procedures, and no further reference will be made to them. It would, at first sight, appear that operations on the peripheral part of the system were in the nature of exercises in dissection. This is to some extent true, and there is much advantage in diligent practice on the cadaver. Yet there are several factors militating against the successful result of routine dissections in the living subject. The first of these is the lack of a consistently uniform anatomical arrangement of the main trunks and of their branches; as a result it may happen that an orthodox operation, theoretically correct according to stereotyped anatomy, may be incomplete and inefficacious (Telford,[85] 1935). Examples of this difficulty will be given when particular operations are considered. The second is a tendency, too often apparent, to employ sympathetic neurectomy as the sole remedial procedure. It may be said, quite categorically, that there is hardly a condition in which sympathectomy may be of value in which it should be so regarded. As an operation, it should remain in the hands of the general surgeon, to be employed by him as an integral and occasionally essential part of treatment, in the setting of a broad clinical outlook on the whole therapeutic problem. This is the more desirable because it may happen that an unsuspected general problem may present itself during the intervention, involving either a wide knowledge of surgical technique, or familiarity with a particular operative procedure, or both.* The third is the practical difficulty, sometimes extremely troublesome, of isolating structures of small size, perhaps through a limited exposure, in the presence of an excessive quantity of fat, or of chronically inflamed contiguous lymphatic tissue.

By far the most important surgical consideration is the answer to the question, how far can sympathectomy secure the results desired without subjecting the patient to physiological inconvenience or disability. This possibility arises as a corollary to the present lack of any really selective procedures. Some of the inconveniences which have resulted in the past have been indicated by surgeons

*The reviewer believes that it would be much better to speak or write of the whole therapeutic problem of each disease in the treatment of which sympathectomy may find a place, rather than of the " surgery of the sympathetic system ".

out of their operative experience, and it will emerge from this review that considerable progress has been made in their elimination, as a result of modifications of technique. Others are still inevitable, but here it may be stated that none is now of such a degree of physiological importance as to weigh against the benefits of operation in carefully chosen cases.

It has seemed to the reviewer advisable to exclude from this paper, as far as possible, detailed consideration of the aetiology of the conditions dealt with. In many instances there is a conflict of opinion on this, and the evidence is lengthy and intricate. Accordingly the sympathetic system will be dealt with in a regional manner; methods of access will be described briefly, the selection of patients considered, and the results of operation indicated.

THE SUPERIOR CERVICAL GANGLION

The superior cervical ganglion is best displayed by formal dissection through an incision along the posterior border of the sternomastoid muscle.

Selection of Patients.—Removal of the superior cervical ganglion has been employed to produce approximation of the eyelids in long-standing cases of facial paralysis: the mechanism has been dealt with by Mutch[62] (1936). Although closure of the eyelids is improved, it appears to the reviewer that modern plastic operations should displace this procedure. It has also been successfully used to improve the blood-supply in ulcerative lesions of the face—for example, after section of the sensory root of the fifth nerve (McKenzie,[58] 1933; writer's experience).

THE STELLATE GANGLION

The stellate ganglion may be exposed by the method of Gask and Ross[25] (1937), or by that described by Leriche[50] (1926), in which the approach is between the clavicular and the sternal portions of the sternomastoid. The latter is the more direct procedure, and gives adequate exposure except when the patient's neck is short and thick.

Selection of Patients.—Of great clinical importance is the application of stellectomy by Leriche[51] (1936) to the treatment of angina pectoris. Leriche holds very definite views on the usefulness of this operation; these are not generally accepted by cardiologists, but his great experience demands their examination. In brief it may be stated that he believes that stellectomy accomplishes three purposes: (1) Interruption of the vasoconstrictor reflex (the cause of the attack); (2) Interruption of afferent pathways for cardiac pain; and (3) Interruption of coronary vasoconstrictor nerves (the orthodox physiological teaching is that sympathetic nerves are dilator to the coronary vessels). Leriche considers that patients showing evidence of marked coronary obliteration, i.e., those presenting the symptom of claudication without effort, are unsuitable for operation. For the remainder, novocain injection of the stellate ganglion on the painful side (usually the left) is employed as a therapeutic test: if this gives relief, operation is performed. He reports favourable results in 70 per cent of cases, after intervals of as long as ten years. He makes the comment, which appears to the writer of supreme importance, that of a series of 24 cases none died a "sudden death". Thus there is some evidence that the operation may improve cardiac nutrition, and this

must be borne in mind in view of the recent tendency to seek an improved blood-supply for the heart in grafts from contiguous structures, or to relieve its task by total thyroidectomy. On the other hand, if further experience should prove that by interruption of sympathetic nerves only the pain of angina can be eliminated, the method of paravertebral injection (p. 442) is simpler, less risky, and more efficacious.

In a limited series of cases, the reviewer has not been able to reproduce the results claimed by Leriche for this procedure.

THE SYMPATHETIC NERVES OF THE EXTREMITIES

Vasoconstrictor and sudomotor nerves to the extremities leave the lateral horns of the grey matter of the spinal cord as axons (pre-ganglionic) which pass by way of the anterior nerve-roots and white rami communicantes to the ganglionated chains, in which they run cranially or caudally for varying distances before forming synapses with ganglion cells. From the latter new (post-ganglionic) axons arise, which pass to the roots of the limb-plexuses in the grey rami communicantes; they are distributed over the peripheral nerves to the musculature of the vessels and to sweat glands, and at the periphery the vascular territory of a nerve is the same as its cutaneous distribution (Todd and Kramer,[88] 1914). The relays of the nerves to the hand occur in the inferior cervical and upper two or three thoracic ganglia, those for the nerves to the foot in the lowest lumbar and upper two sacral ganglia. The presence of two relays in the sympathetic pathway at once raises the question of the level at which division of its fibres will give the best therapeutic result; that is, should sympathetic neurectomy be pre-ganglionic or post-ganglionic? The former can be accomplished by dividing the sympathetic chain below (caudal to) the third thoracic ganglion for the upper extremity, and caudal to the first lumbar ganglion for the lower extremity. The latter can be secured by the removal of the trunk from above the inferior cervical ganglion to below the second or third thoracic ganglion in the case of the upper extremity, and for the lower extremity the trunk from above the origin of the grey rami to the second lumbar nerve to below the origin of the grey rami to the second sacral nerve.

In practice, the orthodox operation for denervation of the lower extremity has consisted in the removal of the lumbar trunk from above the anatomical level of the second lumbar ganglion to below the anatomical level of the fourth lumbar ganglion; this procedure is a pre-ganglionic neurectomy of practically all the sympathetic fibres distributed to the foot by the great sciatic nerve. It has been found to result, in uncomplicated cases, in permanent and maximum freeing of the vessels of the foot from vasoconstrictor control. It has proved more difficult to secure lasting results in the hand, and several hypotheses have been advanced to account for this. Two are of technical importance: (1) Incomplete results are due to incomplete neurectomies, and (2) The usual neurectomy for the upper extremity has been post-ganglionic. The first hypothesis found a basis in the inconstant arrangement of the grey rami for the brachial plexus, to which Kuntz[41] (1927) had drawn attention; but even after the most careful dissections to ensure division of all possible sympathetic pathways, incomplete results and recurrence of vascular symptoms still occur, although absence of sweating proves that the neurectomy has been complete. It is likely that the second hypothesis is the correct one, and that recurrence of vascular symptoms after post-ganglionic neurectomy is due to the sensitivity—even hypersensitivity—of denervated plain muscle to sympathetico-mimetic hormones (adrenaline, sympathin) circulating in the blood-stream (Freeman, Smithwick, and White,[23] 1934; Grant,[28] 1935). For this reason Telford[85] (1935) in this country and Smithwick[81] (1936) in the United States have devised procedures for interrupting the pre-ganglionic fibres to the upper extremity; but Adson,* whose technical skill and large experience command attention, continues to use the post-ganglionic procedure in the belief that the completeness of the neurectomy is the determining factor.

---

* In a personal letter (1937) Dr. Adson has most courteously assembled his present views on various matters dealt with in this paper, and I gladly take this opportunity of thanking him for this kindness.

A. THE UPPER EXTREMITY

1. Post-ganglionic Sympathectomy.—

a. Posterior Routes.—These are based on the anatomical work of Henry[32] (1927), as applied by Adson, and consist in the exposure of the stellate and upper thoracic ganglia after resection of the posterior part of the first or second rib, and the corresponding transverse process. This is accomplished either through a single midline incision permitting access to both sides (Adson and Brown,[3] 1929; Adson,[5] 1934) or by muscle-splitting incisions on both sides (White, Smithwick, Allen, and Mixter,[94] 1933).

b. Anterior Route.—In this operation (Gask and Ross,[25] 1937) the ganglia are approached from in front, freedom of access being obtained by division of the clavicular head of the sternomastoid, and of the scalenus anticus at its insertion.

2. Pre-ganglionic Sympathectomy.—

a. Posterior Route.—This operation has been described by Smithwick[81] (1936). After resection of the posterior part of the third rib, and the corresponding transverse process, the posterior parts of the second and third intercostal nerves are resected from the intervertebral foramina outwards, both anterior and posterior roots being divided; the sympathetic trunk is divided caudal to the third thoracic ganglion, and the cranial end of the cut trunk is sutured in the vertebral muscles. Division of the intercostal nerves ensures the interruption of any additional sympathetic fibres passing from these to the first thoracic nerve (an important step, Kuntz,[41] 1927), while the diversion of the sympathetic trunk guards against its regeneration.

b. Anterior Route.—The exposure is that of Gask and Ross. The local procedure, devised by Telford[85] (1935), consists in the division of the white rami communicantes to the second and third thoracic ganglia, and the crushing and division of the sympathetic trunk caudal to the third thoracic ganglion.

General Comment.—None of these operations is attended by serious risk; all are somewhat intricate and time-consuming. In all, a dry field is essential, and any bleeding in the depths of the wound is best controlled by silver clips and by the use of a suitably curved sucker. The pleura must be respected by deliberate and gentle manipulations. Clear illumination is essential, and best obtained by a good forehead lamp. The arch of the subclavian artery must be studied when the anterior route is employed; usually this vessel is displaced towards the thorax, but occasionally an approach in its concavity is more convenient. Of all forms of anæsthesia the writer much prefers the intratracheal, which is an advantage if the pleura be wounded accidentally. As regards choice of operation, evidence is accumulating that pre-ganglionic section is the method of choice. Its results are clinically good, and post-operative tests have not shown (Smithwick,[81] 1936) any undue sensitivity of the vessels of the hand to circulating adrenaline. Pre-ganglionic neurectomy avoids the Horner's syndrome inevitable if the stellate ganglion is removed, because the results of the operation in the head and neck are limited to vasodilatation and loss of sweating; fibres for the control of the pupil appear to traverse the first thoracic white ramus communicans. Occasionally, at a later date, the lack of sweat on the hands may inconvenience those whose occupation entails fine fingerwork (e.g., seamstresses). This point should be considered before operation is advised, but the disability may be reduced by the regular use of cold cream on the dry fingers.

As regards choice of route, the writer uses the anterior unless the neck is obese, when Smithwick's operation is perhaps the more expeditious if the correct rib is identified by radiography. By either route both sides may be dealt with at one session if desired; it is best to leave a small drain for twenty-four hours if the anterior is chosen. Convalescence is smooth, and the patients leave hospital about the tenth post-operative day.

B. THE LOWER EXTREMITY

Pre-ganglionic fibres for the lower extremity do not leave the spinal cord caudal to the second lumbar white ramus communicans, and therefore lumbar cord sympathectomy is, as has been pointed out, essentially pre-ganglionic as far as the control of the vessels of the foot is concerned, although post-ganglionic elements passing to the femoral artery are interrupted by the removal of the grey rami communicantes to the anterior crural and obturator nerves (L.2, 3, and 4). Orthodox lumbar cord sympathectomy aims at the removal of the chain from above the second lumbar ganglion (which is almost constant) to the brim of the pelvis.

1. *Extraperitoneal Route.*—One of three incisions may be used. That of Royle[76] (1924) extends along the outer border of the erector spinæ to and then above the iliac crest. After separation, and if necessary division, of the flat muscles, the chain is approached by way of the retroperitoneal tissues in front of the psoas muscle. The second is a straight incision from the tip of the eleventh rib to an inch or so below the umbilicus. The muscles are separated or cut, and if necessary the rectus abdominis can be retracted medially after division of the anterior layer of its sheath. A third has recently been advocated (Pearl,[66] 1937); it is entirely a muscle-splitting incision, and should be given an extensive trial.

2. *Transperitoneal Route.*—A left paramedian incision is employed. On the left side the lumbar cord is approached retroperitoneally after the descending colon has been mobilized by division of the lateral leaf of its peritoneum (Adson and Brown,[3] 1929). On the right side the cæcum and ascending colon may be mobilized in a similar way, or the retroperitoneal tissues can be entered through an incision in the peritoneum of the posterior wall lateral to the vena cava.

If it is ultimately proved that sympathetic neurectomy should be pre-ganglionic, then this orthodox operation is too extensive, for the same result could be obtained by simply dividing the chain cranial to the grey rami for the fourth lumbar nerve, a procedure which interrupts the sympathetic contribution to the nerves of the foot. This modified procedure has been recommended by Danielopolu and Aslan[14] (1935), who term it "interlumbosacral sympathectomy", and the writer has employed it independently with satisfaction in lesions of the distal parts of the lower extremities. In his experience the operation can be quickly and easily performed transperitoneally, by incising the peritoneum in the median line over the front of the fourth and fifth lumbar vertebræ, reflecting each leaf outwards, and identifying and dividing the chains on both sides. After division, the caudal end of each chain is turned down and ligatured to the chain at a lower level.

General Comment.—If a unilateral operation is contemplated, an extraperitoneal approach is to be preferred, because of the smooth convalescence; the patient may leave hospital in ten days. If the operation is to be bilateral, the approach should be transperitoneal. After bilateral lumbar cord sympathectomy distension of the intestine occasionally occurs, the operation may be a protracted one, and there is a definite if small risk attached to it, though the experience of

Schmidt[77] (1936) of 4 per cent mortality and 35 per cent of complications is surely unusual. Technical points of importance include the identification and gentle retraction of the ureters; avoidance of extreme traction on the colon; and the greater difficulty on the right side, on which the chain is concealed at intervals by the lumbar veins. To these may be added occasional difficulties such as the presence of a large amount of retroperitoneal fat, and chronic inflammatory changes in the para-aortic lymph-nodes and lymphatic tissue, which may interfere with the recognition and clean dissection of the chain. A very real danger is the presence of an infective lesion (e.g., an ulcer) in the catchment area of these lymphatics; for the dissection may, by tapping the drainage system, lead to infection of the retroperitoneal tissues.* Any such lesion must be carefully treated before operation, which must never be precipitately undertaken in these cases; this is one example of the value of an appreciation of the clinical situation as a whole. Another point of importance is the infolding of peritoneal incisions made for access to the chains: lack of scrupulous care in doing this may lead to the formation of adhesions, especially to the distal part of the small intestine, and particularly in the interlumbosacral operation.

As regards anæsthesia, there is no doubt that spinal anæsthesia is the most satisfactory. The contraction of the bowels which follows it gives room, whether the operation is trans- or extra-peritoneal, and the muscular relaxation reduces the need for retraction. After these operations there is rarely any untoward effect on the function of the pelvic viscera, although a proportion of their nerve-supply has been interrupted. The reproductive function in women is not impaired; on rare occasions (Ross,[74] 1935) there has followed impairment—probably temporary—of the procreative function in men. As in the hands, the use of an emollient on the feet prevents irritation from the dryness of the skin.

SELECTION OF PATIENTS

This type of sympathectomy is usually performed in an endeavour to improve the blood-supply to a limb or limbs, and in particular to the hands and/or feet. The increase in the circulation results from the dilatation of the peripheral vessels which follows division of their extrinsic vasoconstrictor nerves (for review of, and literature on, nervous control of blood-vessels, *see* McDowall,[57] 1935); it is obvious that a maximum increase will be obtained only when the whole vascular tree, without exception, is capable of dilating. It follows that the important pathological factor in preventing a maximum response is the presence of general or local vascular disease, which interferes with the resilience of the arterial walls, reduces or blocks the lumen of arteries, or produces both these results. Subsidiary unfavourable factors may also be present, and these will be noted in the appropriate places.

Thus the first essential in the investigation of these cases is to determine clinically the possibility of vasodilatation. This can be done by measuring the surface temperature of a digit or digits, because the greater the blood-flow through a digit the higher is the temperature of its skin; and conversely the temperature of a digit is a measure of the total blood-flow through it. The clinician therefore requires:—

1. A reasonably delicate method of measuring surface temperature, which in practice

* Every surgeon with much experience of sympathectomy must have encountered this. The writer's own object-lesson was a sequel (fortunately not fatal) to an operation designed to expedite healing in a radium ulcer of the popliteal fossa, of two years' standing.

is usually some form of thermocouple.* It is important to apply this to the finger or toe in such a way that the circulation through the digit is not impeded (e.g., *not* by firm circumferential strapping).

2. A means of producing vasodilatation in the part to be tested. Two methods are useful: (*a*) The production of temporary vasoconstrictor paralysis by the injection of local anæsthetic solution round the appropriate peripheral nerves, or round the appropriate sympathetic ganglia and their rami (paravertebral block); and (*b*) The application of heat to some distant area of the body—this is followed, after a variable interval, by dilatation of the vessels of unheated parts. The most reliable method of applying heat (a matter of great clinical importance) is the immersion of the legs or arms, according to whether the hands or feet are to be tested, in water at a temperature of 43°–45°C. (Gibbon and Landis,[27] 1932; Uprus, Gaylor, and Carmichael,[89] 1936). The testing room should be maintained at an even temperature (18°–20°C.), and should be free from draughts, which tend to cool the surface of the body. If one limb of a pair to be tested is colder than the other, allowance must be made for delay in dilatation of the colder limb (Lewis and Pickering,[54] 1931–33).

It is also possible to utilize as a clinical test the observation (Ingram,[37] 1936) that full vasodilatation of the extremities occurs during sleep. The hands or feet are kept outside the bedclothes, the thermocouple is adjusted, and a reading is taken about an hour after the patient has gone to sleep. The reviewer has found that this simple method gives reliable clinical results.

In normal subjects, the temperature reached by the skin during full vasodilatation varies from patient to patient: in this country under hospital conditions the upper limit is about 36°C, representing a rise of about 20°C. Obviously the figure of importance is the *rise* in the temperature of the digit tested; that is, the difference between the temperatures of the digit (1) at room temperature, and (2) after vasodilatation has been effected and its temperature becomes stabilized at a higher level, both values being considered with reference to the room temperature. When the response is not normal, because of arterial disease, vasodilatation does not produce the normal increase in temperature; but still there may be sufficient arterial resiliency remaining to justify operation. Experience has shown (Morton and Scott[61], 1930) that when the room temperature is 20°C, if the temperature of the tested extremity does not rise above 28°C, nothing is to be gained by performing sympathectomy.

Raynaud's Disease.—This is often a blunderbus diagnosis. The various forms of vasomotor instability included in the term have been separated by Lewis and Pickering[55] (1934), whose paper must be studied in the original by all interested in the subject. Their classification is as follows:—

1. Intermittent spasm of digital arteries, without complications.
2. Intermittent spasm of digital arteries, with local nutritional changes.
3. Intermittent spasm of digital arteries, with generalized scleroderma.
4. Raynaud's phenomenon arising out of local injury, including the use of vibrating tools.
5. Bilateral gangrene of digits in the young, and with infection; this condition is regarded as probably the result of thrombotic closure of vessels.
6. Bilateral gangrene with hæmoglobinuria from cold, a condition having probably a unique pathogeny.
7. Bilateral gangrene of digits in the elderly, in which closure is shown to be thrombotic, but preceded by disease of the small arteries.
8. Thrombo-angiitis obliterans associated with Raynaud's phenomenon.
9. Cervical rib or crutch pressure causing Raynaud's phenomenon or gangrene, so it is thought, by thrombotic and embolic processes.

With the exception of (6), (7), and (9), in any of these conditions the possibility of treatment by sympathectomy arises. The matter is not to be settled by tests

* The reviewer uses a convenient portable apparatus, designed for him by Professor J. A. Carroll, Professor of Natural Philosophy in the University of Aberdeen, and constructed by Messrs. Fraser & McKay, 34, Upperkirkgate, Aberdeen.

alone. The social circumstances of the patient; her work, if any; the severity of the disease; and local climatic conditions: all must be considered. It must be remembered that even after sympathectomy exposure of the affected extremity to cold may still precipitate an attack; therefore patients should be urged to find an occupation which does not involve this. The wearing of warm, unconstricting clothing, from the root of the limb as far distally as practicable, is also a most valuable precaution, although it is often difficult to persuade young women to adopt it. Attention must be given to general health, but the patients are often remarkably fit physically; however, Cobb (quoted by White,[97] 1936) believes that they "have a special psychologic makeup which is perhaps characterized by inner emotional turmoil thoroughly covered and repressed beneath an outwardly normal appearance and behaviour".

In coming to a decision, the almost invariable progressive course of the disease must be kept in mind. In one group the progress is rapid, in another slow, and naturally the late results are better in the latter group. The reviewer believes that operation should be recommended in Groups 1 and 2, if the attacks continue to be troublesome after the patient has placed herself in the best possible environmental conditions. The vessels are not yet diseased, and full vasodilatation is to be expected. In Group 3 operation may be offered, but with less assurance of relief (Ross,[74] 1935), for the vessels are too confined by new fibrous tissue. In Group 4 change of occupation is imperative, and operation should not be offered or undertaken until this has been arranged for. Group 5 should be offered operation, with a view to limiting the process and encouraging repair; here it may be stated that it is the writer's experience that it is wise to defer local surgical treatment for gangrenous areas, however small and superficial, until the parts have ceased to benefit from the improvement in blood-supply after sympathectomy, excepting of course attempts to reduce or abolish infection by suitable dressings, which must precede the sympathectomy. Groups 6 and 7 do not respond to sympathectomy. In Group 9 indirect measures (e.g., tenotomy of the scalenus anticus) are to be preferred.

It is usual to find patients who have been proper subjects for operation uncommonly grateful for the relief afforded. Attacks are less frequent because the dilated vessels remain so after exposures to temperatures which would previously have precipitated vasospasm. The pain of cold fingers is therefore reduced, and the burning pain of rapid vasodilatation disappears. Ulcers heal and in most cases remain healed.

Thrombo-angiitis obliterans.*—When a series of cases of this disease is reviewed, they will be found to fall into certain groups:—

1. An early group, usually (and wrongly) labelled Raynaud's disease in the male.

2. A group in which the disease is very slowly progressive, so slowly that it may appear to reach a certain stage, after which it does not progress. Thus cases are not rare in which claudication has been the only symptom for many (e.g., fifteen) years.

3. A group in which the progress is episodic, the episodes corresponding to waves of thrombosis.

---

* An admirable account of this disease has recently been published by Telford[86] (1937).

4. A group in which the disease progresses rapidly to massive gangrene.

It is in Groups 1 and 2 that sympathectomy is indicated; in these a good or sufficient vasodilator response follows the heating test. The operation may serve one or both of two purposes: it may obviate or at worst delay amputation; or it may allow of a below-knee instead of an above-knee amputation. The reviewer has come to the conclusion (shared by Telford,[86] 1937) that when the disease affects the lower extremities it is unwise to consider the problem as unilateral, the so-called sound leg often being 'sound' only because it has been spared by the earlier appearance of claudication in the other. Therefore the operation should be bilateral, except when one leg must obviously be amputated; in these circumstances nothing should be omitted that might improve the circulation in the remaining limb, which will have to undertake an increased burden, both in support and in progression. The writer feels that an operation on a middle-aged adult, which merely defers amputation, is psychologically wrong; and he would strongly advise against 'whittling' surgery, which hospitalizes even patients of great fortitude and understanding.

Crushing the peripheral nerves to an ulcerated area has been advocated (Smithwick and White,[80] 1930). This procedure is intended to abolish pain, and also to cause a rise in surface temperature by interrupting the local vasoconstrictor nerves. The relief lasts for about six months, and the method may be considered in episodic cases to gain time for the possible development of an adequate collateral circulation, without requiring the patient to endure the pain of ulceration.

In certain cases of thrombo-angiitis obliterans, in which the process is marked in a vessel providing few collateral channels (e.g., superficial femoral), arteriectomy has been employed (Leriche, Fontaine, and Dupertuis,[53] 1937). The procedure is based on the view that "an obliterated artery functionally ceases to be an artery, but becomes a diseased plexus of sympathetic nerve-fibres provoking distal vasospasm in the anastomotic network of vessels". The localization of the obliterated segment is determined by arteriography with thorotrast. In Leriche's practice, the results obtained in suitable cases are similar to those after lumbar sympathectomy (Leriche and Fontaine,[52] 1936).

The reviewer believes that when an operative attempt to improve the circulation is indicated, lumbar sympathectomy should be chosen. Each case must be dealt with after consideration of the history, the present condition, the patient's occupation, and his mental outlook. Every attempt should be made to cleanse gangrenous areas and ulcers before operation. It is to be noted that 'rest' pain is more likely to be diminished or abolished by sympathectomy than is the pain of claudication (Ross,[74] 1935). In giving a prognosis, the possibility of the disease affecting other vessels should be remembered; most common in the vessels of the leg, it may also be present in those of the arm. Indeed no vascular territory is exempt; and the reviewer has had the experience of 'saving' a young man's legs by sympathectomy only to admit him to hospital a year later for hemiparesis of vascular origin—a rare but significant complication.

Hyperidrosis.—Excessive sweating may interfere with the comfortable performance of a patient's occupation, and may even (reviewer's experience) rapidly destroy clothing such as boots. Sweating over a given area can be abolished at once and permanently by a suitably planned sympathetic neurectomy or by paravertebral alcohol block. Charts showing the areas rendered dry after various

procedures are available (Pieri,[69] 1932). It is the writer's experience that if large areas be deprived of their sympathetic nerve-supply, there is a tendency to increased sweating over the remainder of the body.

Poliomyelitis.—It is natural that sympathectomy should have been employed in attempts to benefit the cold, blue, sometimes ulcerated, lower limb which may be a sequel to poliomyelitis. This complication is much more common in females (Ogilvie,[63] 1932; Telford and Stopford,[82] 1933). The results (Ross,[74] 1935) have been encouraging, and a considerable measure of relief is to be expected, except when (1) there is little muscular power remaining in the limb, (2) ulceration is extensive, and (3) the cutaneous lesions affect the proximal part of the limb. Occasionally some increase in the length of a shortened limb has been noted (Harris,[29] 1930; Ogilvie,[63] 1932).

Arthritis.—Sympathectomy for arthritis was introduced by Rowntree and Adson[75] (1927); their rules for the selection of cases (Hench, Henderson, Rowntree, and Adson,[31] 1930) follow:—

1. The 'arthritis' should be chiefly periarticular or synovial (capsular) with little, if any, bony alterations (destruction or hypertrophy) except atrophy.
2. Patients preferably should demonstrate some of the alterations in vasomotor tonus, shown objectively by cold, clammy, sweating hands and feet, reduction of blood-pressure (approximately below 100 to 115 systolic), and subjectively by intermittent numbness and tingling.
3. Vasomotor alterations must be capable of correction, or of overcorrection, by means of release from control of the sympathetic apparatus.
4. The patient should be preferably less than thirty-five years of age, and not more than the age of forty-five years.
5. The arthritis should be progressive, and the main disability should be confined to the extremities, particularly to the hands and feet. If the arthritis is not progressive, continuation of the therapeutic programme already established may accomplish satisfactory results.
6. A reasonable period, probably at least six to twelve months, of intensive, not haphazard, treatment by the more established, less radical procedures should be allowed before resection of sympathetic ganglia and trunks should be considered. However, rapidity of progression or stress of economic circumstances may necessitate consideration of earlier surgical measures.

Such cases belong to the group known in this country as 'primary rheumatoid arthritis', and the majority of recorded cases have conformed to it.

Results.—The local warmth and dryness after sympathectomy are of themselves comforting, and this may have a certain psychological effect. Relief of pain can be counted on in favourable cases (Adson,[4] 1933); this appears at once and applies both to rest and to pain on movement. Reduction in the size of affected joints, and increase in their mobility, are less frequently observed; but in successful cases the total function of a limb, for example in walking, may exceed that to be expected from the local improvement in the movement of its joints. Adson[4] (1933) has recorded a carefully observed series of 37 cases, with failure in 6, slight improvement in 11, and marked improvement in 20. The last group contained the cases with the shortest history, and many were able to carry on regular work. When 10 cases belonging to this group were reviewed, he found that "arthritis progressed, in extremities for condition of which operation was not done, in six cases, remained stationary in two, and improved in two". This important observation shows how continuously the results of any form of treatment of arthritis must be assessed.

Occasionally the operation has been applied in cases in which destructive changes were present in the joints (Young,[101] 1936); in an elderly patient (Young,[101] 1936), and in a proximal (shoulder) joint (Gask and Ross,[25] 1937): favourable results were recorded in these cases.

The writer (Learmonth,[47] 1937) has recently reviewed the literature on this subject. The results have been characterized by a striking absence of uniformity, even in apparently comparable cases, and it is clear that sympathectomy cannot be regarded as direct treatment for the disease rheumatoid arthritis. Improvement has followed most frequently when careful selection of cases has been made according to the criteria quoted above; however, even when this has been done failures have been recorded by experienced surgeons (e.g., White,[96] 1935). In short, collective experience indicates a conservative attitude towards this application of sympathectomy.

In the painful post-traumatic osteoporosis of Sudeck, there is much evidence of the value of sympathectomy in the treatment of those cases which resist conservative methods (Fontaine and Herrmann,[22] 1933; White,[96] 1935). Apparently the vasodilatation need not be permanent, for successful cases have been recorded after the paravertebral injection of novocain and of alcohol, and after periarterial operations, as well as after orthodox lumbar and cervico-thoracic sympathectomy.

Chronic Ulceration of the Legs.—When an indolent varicose ulcer resists conservative measures, an attempt may be made to secure healing by performing lumbar sympathectomy, excising the ulcer, and applying skin-grafts after 7–10 days (Craig,[11] 1930). The reviewer has used this method with success. Particular attention must be given to the preoperative disinfection of the ulcer.

PERIARTERIAL SYMPATHECTOMY

The removal of the adventitia of an artery at the root of a limb is one of the oldest procedures in this branch of surgery (Leriche,[48] 1913). Its sphere of usefulness has steadily diminished, because of the transient nature of its physiological results; the increased warmth which follows it seems to last, at most, for five weeks (Rogers,[72] 1931). Periarterial sympathectomy may be employed in elderly patients suffering from limited gangrene (e.g., of a toe), when the pain is troublesome and the process of demarcation likely to be protracted. Though the results are uncertain, relief of pain and more rapid healing have been recorded in a sufficient number of cases (Gask and Ross,[25] 1937; Young,[99] 1931) to justify the opinion (Gask and Ross,[25] 1937) that "it may do good, and if it does not, it will certainly have done no harm". The precise mechanism which produces improvement is at present unknown.

ESSENTIAL HYPERTENSION

It appears to the reviewer that judgement on the various surgical measures proposed to deal with essential hypertension had best be deferred until after the discussion on the subject at the International Surg cal Congress next year. Thoughtful editorials dealing with the matter have appeared in this country (*Brit. Med. Jour.*,[19] 1937) and in the United States (Dragstedt,[18] 1937). The procedures which have been used are designed: (1) to lead to vasodilatation in the splanchnic area (Peet,[67]

1937); (2) to lead to vasodilatation in both splanchnic and somatic areas (Adson, Craig, and Brown,[6] 1936); or (3) to lead to vasodilatation in the splanchnic area and also to reduce the amount of adrenal tissue by partial adrenalectomy (Adson, Craig, and Brown,[6] 1936). A good general account of the problem has been given by Adson and Allen[7] (1937).

THE MODIFICATION OF VISCERAL FUNCTION

A. ALIMENTARY TRACT

1. Pharynx and Œsophagus.—The spasm of the sphincter at the lower end of the pharynx, which is met with in women together with anæmia and atrophy of the mucosa, has been treated (Rogers,[73] 1935) by removal of both superior cervical ganglia; these provide sympathetic fibres for the pharynx. The good result persisted at least two years. Experimental work on animals (Knight,[39] 1934) seemed to indicate that sympathetic denervation of the lower end of the œsophagus (Knight,[40] 1935) by resection of the coronary artery with the nerve-fibres surrounding it, might prove successful in resistant cases of cardiospasm. On the whole, however, the results of this procedure have been disappointing (Gask and Ross,[25] 1937); nor is it likely that the bilateral cervico-thoracic sympathectomy recommended by others (Craig, Moersch, and Vinson,[13] 1934) will be more uniformly successful, for in the late stages of the condition the œsophagus does not retain its normal muscularity.

2. Colon.—The known inhibitory effect of stimulation of the sympathetic nerves to the colon on the activity of its musculature (Garry,[24] 1934; Learmonth and Markowitz,[44] 1930) has led to the employment of sympathetic neurectomy in cases of constipation, the more so as it had been noted by Royle that after lumbar cord ganglionectomy this symptom became less troublesome. The sympathetic nerves to the distal part of the colon alone have been subjected to operation, because these are concentrated about the inferior mesenteric artery as a periarterial plexus, and in the superior hypogastric plexus (presacral nerve) as a loose meshwork (Telford and Stopford,[84] 1934; Mitchell,[60] 1935). The sympathetic supply of the distal colon is provided by mesially directed branches of the lumbar paravertebral chains, and their interruption has been accomplished in several ways:—

a. By unilateral (left) or bilateral lumbar cord sympathectomy (Judd and Adson,[38] 1928). This procedure interrupts in addition the vasoconstrictor nerves to the lower extremities.

b. By transperitoneal resection of the presacral nerve (which controls the internal sphincter ani) and removal of the plexus round the inferior mesenteric artery (Rankin and Learmonth,[71] 1930). This procedure leads to sterility from loss of ejaculation in the male, though coitus and orgasm are unaltered (Learmonth,[45] 1931), and this is a serious psychological defect. The reproductive function in women is not affected.

c. By transperitoneal division of the mesially directed branches of the lumbar chains (Telford,[83] 1934). This is the most selective operation, and is much the best procedure in males, in the absence of great technical difficulty. In females the equally efficacious operation (*b*) is more quickly and easily performed.

Selection of Patients.—Originally it was hoped that the operation might improve the function of the colon in long-standing cases of constipation. Time has shown that this does not occur, and therefore sympathetic neurectomy is not recommended in this type of case.

The operation has a useful place in the treatment of patients suffering from the rare condition of Hirschsprung's disease (better termed 'megacolon') when medical treatment fails. It seems quite clear that there is, in this condition, some defect in the neuromuscular mechanism of the distal colon, and/or the internal sphincter ani (Adamson and Aird,[2] 1932; Hurst,[36] 1934), although the precise nature of the defect has not been settled. As a pre-operative test, a barium enema may be given, and the colon watched under the screen after a spinal anæsthetic has been administered. Marked increase in colonic activity, and the expulsion of part of the enema, indicate the suitability of the case for sympathetic neurectomy (Morton and Scott,[61] 1930).

The results of operation are gratifying and often dramatic (Gask and Ross,[25] 1937; reviewer's experience), and appear to be permanent. The usual care in forming habits should never be omitted, and if occasional assistance is required, liquid paraffin is best; the co-operation of both patient and parents is essential.

It may be noted that in a proportion of cases dilatation of the bladder and/or ureters is associated with megacolon. This is additional evidence in favour of a neurogenic origin of the condition, for the distal colon and the lower urinary tract have a common sympathetic nerve-supply. When this association is present, the urinary tract shares in the post-operative improvement.

B. URINARY TRACT

1. Renal Pelvis.—The small painful hydronephrosis in which no structural obstruction can be found has been a difficult therapeutic problem. Anatomical and physiological information regarding the renal nerves is fairly complete (Quinby,[70] 1916). It was suggested (Papin and Ambard,[65] 1922) that the failure of the renal reservoirs to empty might be due to neuromuscular inco-ordination of the papillary muscles and pelvis. This hypothesis has been tested (Harris and Harris,[30] 1930; Hess,[33] 1930; Oldham,[64] 1936) by the operation of stripping the renal pedicle so as to detach the nerve-fibres accompanying the renal vessels. This is carried out through the usual lumbar incision, and the local technique is important (Oldham,[64] 1936).

Selection of Patients.—Delay in emptying of the renal pelvis, with blunting of the contour of the calices, is suggestive; and more rapid emptying and relief from pain after the subcutaneous injection of eserine provide confirmatory evidence of what has been termed 'renal sympatheticotonus'. The results recorded have been good; the relief of pain has been emphasized. A disadvantage of the procedure would seem to be the risk of leaving the kidney and its pelvis permanently insensitive.

2. Ureter.—Neuromuscular inco-ordination, of the nature of achalasia at the uretero-vesical juncture, offers an explanation of the occurrence of dilatation of one or both ureters, an idiopathic condition often disclosed in cases of persistent urinary infection in children. It is known that stimulation of the sympathetic fibres in the presacral nerve leads to closure of the ureteral orifice, and this nerve has been divided in the hope that adequate drainage of the ureter would follow (Ward,[91] 1933; Learmonth and Braasch,[46] 1933).

Selection of Patients.—Persistence of urinary infection in children may be due to this condition, which may be verified by intravenous urography. When stretching

by bougies fails, operation may be tried. After operation,* the ureter drains much more adequately, and this result appears to be permanent (Gask and Ross,[25] 1937; reviewer's experience). Post-operative diminution of the ureteral calibre depends on the state of the wall of the tube. A serious defect of the operation is that it leads to sterility in males. In unilateral cases the reviewer has divided only the corresponding hypogastric nerve; the subsequent history of the cases will show whether ejaculation is possible in these circumstances.

3. Bladder.—The dual innervation of the bladder, and the easy accessibility of its sympathetic fibres in the presacral nerve, prompted the hope that its expulsive power might be improved by interrupting its sympathetic supply, and so removing inhibitory fibres, in cases where a lesion of the motor (parasympathetic) pathway existed (Learmonth and Braasch,[43] 1930).

Selection of Patients.—Although a number of encouraging successes have been recorded, on the whole the results of this operation have been disappointing. It is likely that its use will be restricted, but it may be possible to select suitable cases by more detailed clinical and neurological examination (Thomson-Walker,[87] 1917), and by the estimation of bladder pressure (Denny-Brown and Robertson,[16] 1933; Watkins,[90] 1936). Presacral neurectomy has been added to abdomino-perineal resection of the rectum, in an endeavour to avoid post-operative retention; this would appear to be reasonably successful (Abel,[1] 1937).

There exists a group of cases of dilatation of the bladder, and possibly ureters, in which organic obstruction is absent, the lesion being neuromuscular incoordination, possibly of the nature of achalasia of the internal sphincter of the bladder. Most frequent in children, it may also be encountered in adults. When a 'punch' operation on the vesical neck fails to secure evacuation of the bladder, presacral neurectomy may be tried, since it has been shown (Learmonth,[45] 1931) that the internal sphincter contracts on stimulation of the vesical sympathetic nerves.

After any of these operations, an indwelling catheter should be maintained in position so long as the patient is in bed, and the same attention to habit formation should be prescribed as in cases of megacolon.

THE RELIEF OF PAIN

Pain fibres from the viscera have the same morphological arrangement as somatic afferent fibres; that is, they are the axons of cells in the posterior root ganglia. Some of these fibres utilize sympathetic pathways to reach the spinal cord. They leave a viscus by its individual nerve-strands, usually traverse peripheral sympathetic ganglia, and the majority reach the paravertebral sympathetic chains by way of the pelvic splanchnic nerves (pelvic viscera), thoracic splanchnic nerves (abdominal viscera), and cervical splanchnic nerves (thoracic viscera). After entering the paravertebral chains they may run cranially (or caudally) for varying distances; finally they traverse white rami communicantes, and thence pass by way of the posterior root ganglia and the posterior nerve-roots to the spinal cord. This tortuous course provides an opportunity for wide 'spread', and it follows that the farther from a viscus they are attacked, the more extensive is the procedure necessary. Although the mechanism of production of visceral pain cannot be regarded as finally settled, the majority of observers are agreed that it arises as the result of tension in the viscus, whether this is the result of distension, of inability to evacuate its contents, or of inco-ordinated muscular contraction. These factors may be reduced to disturbance of function, and it is often difficult

* A ureteral catheter should be left in each dilated ureter for forty-eight hours.

after a successful sympathectomy for pain, to assess the separate contributions of correction of disturbed function of neurogenic origin, and of division of afferent fibres (e.g., the small painful hydronephrosis).

1. **Von Gaza's[26] (1924) Operation.**—In this procedure the white rami communicantes of any of the lower nine thoracic nerves are resected through an incision exposing the posterior ends of the appropriate ribs.

Selection of Patients.—This operation has been employed by its inventor and others (Archibald,[8] 1928; Scrimger,[78] 1929) in cases of intractable visceral pain in the thorax and upper part of the abdomen, in which clinical investigation, and even exploratory operation, have failed to reveal organic lesions. The rami to be cut may be identified in either of two ways: (1) by the "trial and error" method of paravertebral novocain block at various levels (White,[93] 1930), until the pain disappears; or (2) by the induction of spinal anæsthesia, and, as the level of the analgesia spreads cranially, the determination of the level at which the pain is relieved.

Probably the method of paravertebral injection of alcohol after (diagnostic) novocain will replace this operation.

2. **Paravertebral Alcohol Block.**—This is a chemical sympathectomy, by which the rami communicantes are destroyed by the placement around them of 95 per cent alcohol, after a preliminary injection of novocain.

Selection of Patients.—Although the method may be employed for any of the thoracic rami communicantes, it has found its greatest sphere of usefulness in angina pectoris. The innervation of the heart has been very carefully studied (White,[95] 1934). Afferent cardiac fibres reach the spinal cord by the posterior roots of the upper five thoracic nerves and the corresponding white rami communicantes, and it is logical to interrupt their concentration in the white rami rather than their 'spread' in the cardiac nerves. Since the pain is usually referred to the left side, the injections are, in the first instance, unilateral. The anatomical approach is that of Labat[42] (1924), and the technical details have been amplified by White[92] (1929). Large series of cases have been reported (Mandl,[59] 1935; White,[98] 1936), in which relief was complete in approximately 70 per cent of cases; in only 14 per cent was there no benefit. There does not appear to be any disadvantage in the inevitable simultaneous interruption of cardiac efferent sympathetic fibres.

The precise placement of the alcohol is difficult, and should be practised on the cadaver; and for some weeks there is often painful hyperæsthesia of the skin of the chest. However, the procedure does not tax the patients, and carries less risk than the alternative, total thyroidectomy. If the pain returns the injections can be repeated.*

3. **Resection of the Presacral Nerve.**—There is some evidence that resection of the presacral nerve alleviates pain originating in the pelvic viscera, as distinct from the pain resulting from, e.g., cancerous invasion of the lumbosacral plexuses (Pieri,[68] 1930; Learmonth and Braasch,[46] 1933). The majority of the afferent fibres from these viscera reach the spinal cord by way of the pelvic nerves, so that sympathectomy can never lead to complete relief; moreover, the ovary

* The reviewer regards this as a very satisfactory procedure; in one of his patients relief from pain has now lasted three and a half years.

and the body of the testis receive independent nerve-supplies, from the plexuses round the ovarian and spermatic vessels. Interruption of the pelvic nerves is not feasible, because they provide functional nerves for the rectum and bladder, and the spermatic and ovarian plexuses cannot be removed without injury to the vessels which they accompany.

Selection of Patients.—The operation may be tried in painful chronic inflammatory disease of the bladder if other measures fail; although occasionally worth while, the results are, on the whole, disappointing. In the cat it is not possible to obtain evidence, in the form of action potentials, of afferent fibres from the bladder traversing the sympathetic system (Evans,[20] 1936).

It has been extensively and successfully employed in the treatment of dysmenorrhœa which has resisted more conservative procedures (Davis,[15] 1934; Fontaine and Herrmann,[21] 1932; Cotte,[10] 1932). The indications for the operation (Donaldson,[17] 1936) are the failure of dilatation and curettage, and the presence of severe pain with scanty flow and an undeveloped uterus; premenstrual pain is a contra-indication.

4. Sympathectomy for Causalgia.—When causalgia persists, or when it rapidly reduces the moral fibre of a patient, sympathectomy has been employed for its relief. Originally the periarterial operation was performed (Leriche,[49] 1917), and good results have been reported in many cases; but the wisest course (Gask and Ross,[25] 1937) in these emotionally unstable subjects is to perform the permanent operation for the hand, or foot. The results appear to be good, and to be attributable (Gask and Ross,[25] 1937) "to the effect of the operation upon the blood-vessels, or upon the concentration of pain producing chemical substances in the tissues supplied by them".

CONCLUSIONS

What may be called the modern period in the surgery of the sympathetic system has now lasted fourteen years. This interval has been characterized, on the whole, by restriction of its applications. The hypothesis that sympathetic neurectomy would diminish spasticity of muscle has not been sustained; its use in epilepsy has been rightly discontinued; and it has not proved of value in such conditions as bronchial asthma, retinitis pigmentosa, atypical types of facial neuralgia, and meralgia paraesthetica. The results of interruption of the nerve-supply of the bladder have been disappointing, and in rheumatoid arthritis sympathectomy has a restricted field. But out of a better understanding of its limitations there is slowly crystallizing a better understanding of its possibilities; and the future usefulness of sympathetic neurectomy will be determined by its thoughtful application to individual clinical problems, rather than by its blind employment as a specific therapeutic measure.

REFERENCES

As text-books there are available those of Gask and Ross,[25] Hesse,[34] Livingston,[56] and White.[96] The historical aspect has been dealt with by Sheehan,[79] and by Young.[100] At intervals (usually yearly) White publishes in the *New England Journal of Medicine* a most valuable summary of progress in the surgery of the autonomic nervous system. Many of the articles contain anatomical details; the best complete account, together with admirable plates,

will be found in Hovelacque.[35] The remaining references have been so selected that a reader interested in a particular aspect will find the literature on the matter made available in the several bibliographies; I am indebted to Mr. Davidson and Mr. Logie, my University assistants, for help in their compilation.

[1] ABEL, A. L., *Brit. Med. Jour.*, 1937, i, 1297.
[2] ADAMSON, W. A. D., and AIRD, I., *Brit. Jour. Surg.*, 1932, xx, 220.
[3] ADSON, A. W., and BROWN, G. E., *Surg. Gynecol. and Obst.*, 1929, xlviii, 577.
[4] ADSON, A. W., *Ann. of Internal Med.*, 1933, vi, 1044.
[5] ADSON, A. W., *Amer. Jour. Surg.*, 1934, xxiii, 287.
[6] ADSON, A. W., CRAIG, W. McK., and BROWN, G. E., *Surg. Gynecol. and Obst.*, 1936, lxii, 314.
[7] ADSON, A. W., and ALLEN, E. V., *Proc. Staff Meet. Mayo Clinic*, 1937, xii, 1, 49, 75.
[8] ARCHIBALD, E., *Ann. of Surg.*, 1928, lxxxviii, 499.
[9] CANNON, W. B., LEWIS, J. T., and BRITTON, S. W., *Boston Med. and Surg. Jour.*, 1927, cxcvii, 514.
[10] COTTE, G., *Chirurgie du Sympathique pelvien en Gynécologie*, 1932. Paris: Masson et Cie.
[11] CRAIG, W. McK., *Proc. Staff Meet. Mayo Clinic*, 1930, v, 194.
[12] CRAIG, W. McK., and KERNOHAN, J. W., *Surg. Gynecol. and Obst.*, 1933, lvi, 767.
[13] CRAIG, W. McK., MOERSCH, H. J., and VINSON, P. P., *Proc. Staff Meet. Mayo Clinic*, 1934, ix, 749.
[14] DANIELOPOLU, D., and ASLAN, A., *Bull. de l'Acad. de Méd.*, 1935, cxiii, 619.
[15] DAVIS, A. A., *Brit. Med. Jour.*, 1934, ii, 1.
[16] DENNY-BROWN, D., and ROBERTSON, E. G., *Brain*, 1933, lvi, 397.
[17] DONALDSON, M., *Proc. Roy. Soc. Med.*, 1936, xxix, 947.
[18] DRAGSTEDT, L. R., *Surg. Gynecol. and Obst.*, 1937, lxv, 113.
[19] EDITORIAL, *Brit. Med. Jour.*, 1937, July 10, 70.
[20] EVANS, J. P., *Jour. of Physiol.*, 1936, lxxxvi, 396.
[21] FONTAINE, R., and HERRMANN, L. G., *Surg. Gynecol. and Obst.*, 1932, liv, 133.
[22] FONTAINE, R., and HERRMANN, L. G., *Ann. of Surg.*, 1933. xcvii, 26.
[23] FREEMAN, N. E., SMITHWICK, R. H., and WHITE, J. C., *Amer. Jour. Physiol.*, 1934, cvii, 529.
[24] GARRY, R. C., *Physiol. Reviews*, 1934, xiv, 103.
[25] GASK, G. E., and ROSS, J. P., *The Surgery of the Sympathetic Nervous System*, 2nd ed., 1937. London: Balliière, Tindall & Cox.
[26] VON GAZA, W., *Arch. f. klin. Chir.*, 1924, cxxxiii, 479.
[27] GIBBON, J. H., and LANDIS, E. M., *Jour. Clin. Invest.*, 1932, xi, 1019.
[28] GRANT, R. T., *Clin. Science*, 1935, ii, 1.
[29] HARRIS, R. I., *Jour. Bone and Joint Surg.*, 1930, xxviii, 859.
[30] HARRIS, S. H., and HARRIS, R. G. S., *Brit. Jour. Urol.*, 1930, ii, 367.
[31] HENCH, P. S., HENDERSON, M. S., ROWNTREE, L. G., and ADSON, A. W., *Jour. of Lab. and Clin. Med.*, 1930, xv, 1247.
[32] HENRY, A. K., *Exposures of Long Bones and Other Surgical Methods*, 1927. Bristol: John Wright & Sons Ltd.
[33] HESS, E., *Pennsylvania Med. Jour.*, 1930, xxxiii, 741.
[34] HESSE, E., *Die Chirurgie des vegetativen Nervensystems mit Ausnahme des periarteriellen sympathischen Geflechtes der Extremitäten*, 1930. Moscow and Leningrad: Staatsverlag.
[35] HOVELACQUE, A., *Anatomie des Nerfs craniens et rachidiens et du Système grand sympathique chez l'Homme*, 1927. Paris: Gaston Doin et Cie.
[36] HURST, A. F., *Guy's Hosp. Rep.*, 1934, lxxxiv, 317.
[37] INGRAM, P. W., *Edin. Med. Jour.*, 1936, xliii, 672.
[38] JUDD, E. S., and ADSON, A. W., *Ann. of Surg.*, 1928, lxxxviii, 479.
[39] KNIGHT, G. C., *Brit. Jour. Surg.*, 1934, xxii, 155.
[40] KNIGHT, G. C., *Ibid.*, 1935, xxii, 864.
[41] KUNTZ, A., *The Autonomic Nervous System*, 1927. Philadelphia: Lea & Febiger.
[42] LABAT, G., *Regional Anæsthesia*, 1924. Philadelphia: W. B. Saunders Co.
[43] LEARMONTH, J. R., and BRAASCH, W. F., *Surg. Gynecol. and Obst.*, 1930, li, 494.
[44] LEARMONTH, J. R., and MARKOWITZ, J., *Amer. Jour. Physiol.*, 1930, xciv, 501.
[45] LEARMONTH, J. R., *Brain*, 1931, liv, 147.
[46] LEARMONTH, J. R., and BRAASCH, W. F., *Zeits. f. urol. Chir.*, 1933, xxxvi, 195.
[47] LEARMONTH, J. R., *Reports on Chronic Rheumatic Diseases*, No. 3, 1937, 8. London: H. K. Lewis & Co. Ltd.
[48] LERICHE, R., *Lyon chir.*, 1913, x, 378.
[49] LERICHE, R., *Presse méd.*, 1917, xxv, 513.

[50] LERICHE, R., *Lyon chir.*, 1926, xxiii, 763.
[51] LERICHE, R., *Progrès méd.*, 1936, July 11, 1145.
[52] LERICHE, R., and FONTAINE, R., *Mém. de l'Acad. de Chir.*, 1936, lxii, 877.
[53] LERICHE, R., FONTAINE, R., and DUPERTUIS, S. M., *Surg. Gynecol. and Obst.*, 1937, lxv, 149.
[54] LEWIS, T., and PICKERING, G. W., *Heart*, 1931–33, xvi, 115.
[55] LEWIS, T., and PICKERING, G. W., *Clin. Science*, 1934, i, 327.
[56] LIVINGSTON, W. K., *The Clinical Aspects of Visceral Neurology*, 1935. London: Baillière, Tindall & Cox.
[57] MCDOWALL, R. J. S., *Physiol. Reviews*, 1935, xv, 98.
[58] MCKENZIE, K., *Canad. Med. Assoc. Jour.*, 1933, xxix, 492.
[59] MANDL, F., *Wien. klin. Woch.*, 1935, xlviii, 490.
[60] MITCHELL, G. A. G., *Edin. Med. Jour.*, 1935, xlii, 11.
[61] MORTON, J. J., and SCOTT, W. J. M., *Jour. Clin. Invest.*, 1930, ix, 235.
[62] MUTCH, J. R., *Edin. Med. Jour.*, 1936, xliii, 743.
[63] OGILVIE, W. H., *Proc. Roy. Soc. Med.*, 1932, xxvi, 429.
[64] OLDHAM, J. B., *Liverpool Med.-Chir. Jour.*, 1936, xliv, 81.
[65] PAPIN, E., and AMBARD, L., *Arch. des Mal. des Reins*, 1922, i, 1.
[66] PEARL, F. L., *Surg. Gynecol. and Obst.*, 1937, lxv, 107.
[67] PEET, M. M., *Univ. Hosp. Bull., Ann Arbor*, 1937, iii, 1.
[68] PIERI, G., *Arch. ital. di Chir.*, 1930, xxvii, 454.
[69] PIERI, G., *Ibid.*, 1932, xxxi, 117.
[70] QUINBY, W. C., *Jour. of Exper. Med.*, 1916, xxiii, 535.
[71] RANKIN, F. W., and LEARMONTH, J. R., *Ann. of Surg.*, 1930, xcii, 710.
[72] ROGERS, L., *Brit. Jour. Surg.*, 1931, xix, 52.
[73] ROGERS, L., *Ibid.*, 1935, xxii, 829.
[74] ROSS, J. P., *Ibid.*, 1935, xxiii, 433.
[75] ROWNTREE, L. G., and ADSON, A. W., *Jour. Amer. Med. Assoc.*, 1927, lxxxviii, 694.
[76] ROYLE, N. D., *Med. Jour. Australia*, 1924, i, 77.
[77] SCHMIDT, L., *Zentralb. f. Chir.*, 1936, lxiii, 1524.
[78] SCRIMGER, F. A. C., *Canad. Med. Assoc. Jour.*, 1929, xxi, 184.
[79] SHEEHAN, D., *Arch. of Neurol. and Psychiat.*, 1936, xxxv, 1081.
[80] SMITHWICK, R. H., and WHITE, J. C., *Surg. Gynecol. and Obst.*, 1930, li, 394.
[81] SMITHWICK, R. H., *Ann. of Surg.*, 1936, civ, 339.
[82] TELFORD, E. D., and STOPFORD, J. S. B., *Brit. Med. Jour.*, 1933, ii, 770.
[83] TELFORD, E. D., *Lancet*, 1934, i, 444.
[84] TELFORD, E. D., and STOPFORD, J. S. B., *Brit. Med. Jour.*, 1934, i, 572.
[85] TELFORD, E. D., *Brit. Jour. Surg.*, 1935, xxiii, 448.
[86] TELFORD, E. D., *Lancet*, 1937, March 6, 549.
[87] THOMSON-WALKER, J., *Ibid.*, 1917, li, 173.
[88] TODD, T. W., and KRAMER, J. G., *Anat. Record*, 1914, viii, 243.
[89] UPRUS, V., GAYLOR, J. B., and CARMICHAEL, E. A., *Clin. Science*, 1936, ii, 301.
[90] WATKINS, K. H., *Brit. Jour. Surg.*, 1936, xxiii, 734.
[91] WARD, R. O., *St. Bart.'s Hosp. Rep.*, 1933, lxvi, 17.
[92] WHITE, J. C., *Arch. of Neurol. and Psychiat.*, 1929, xxii, 302.
[93] WHITE, J. C., *Amer. Jour. Surg.*, 1930, ix, 264.
[94] WHITE, J. C., SMITHWICK, R. H., ALLEN, A. W., and MIXTER, W. J., *Surg. Gynecol. and Obst.*, 1933, lvi, 651.
[95] WHITE, J. C., *Proc. Assoc. Research Nerv. Ment. Dis.*, 1934, xv, 181.
[96] WHITE, J. C., *The Autonomic Nervous System*, 1935. London: Henry Kimpton.
[97] WHITE, J. C., *Jour. Amer. Med. Assoc.*, 1936, cvii, 350.
[98] WHITE, J. C., *New Eng. Jour. Med.*, 1936, ccxv, 453.
[99] YOUNG, A., *Glas. Med. Jour.*, 1931, cxv, 273.
[100] YOUNG, A., *Emanuel Libman Anniversary Volumes*, 1932, iii, 1253. New York: International Press.
[101] YOUNG, A., *Brit. Med. Jour.*, 1936, ii, 375.

VISITS TO SURGICAL CLINICS AT HOME AND ABROAD

THE CENTRAL EMERGENCY HOSPITAL, MOSCOW

In Moscow all the emergency surgery, medicine, and gynæcology is taken to a single institution, the Central Emergency Hospital of Sklifassovsky, so named after the well-known Russian surgeon. This hospital was founded in 1803 by a Russian aristocrat, Count Sheremetief, as a present to his young wife. It was built on the site of some primitive dwellings in which sick persons had up to that time been attended. The Count's girl-wife had shown interest in this form of philanthropy —an unusual trait in a Russian countess of that era, but possibly explained by the fact that she was a *ballerina*, a blacksmith's daughter whom romance had lifted to what was then regarded as a high station.

Before the Great War the Sheremetief Hospital was the Salpêtrière of Moscow, but it was renamed and reconstituted after the October revolution of 1917, like many other public buildings and institutions in the Soviet Republic.

DEPARTMENTS

The present buildings stand well back from the road and are divided into general surgical, traumatological, gynæcological, and medical blocks, with a "polyclinic" or casualty department for dealing with emergency out-patients who are not afterwards admitted. The beds available at the time of my visit were :—

General surgical	175
Traumatic	250
Medical	130
Gynæcological	75

This makes a total of 630 beds for in-patient emergency cases, and 300 more beds are under construction.

The surgical department admits all abdominal emergencies, such as acute appendicitis, acute intestinal obstruction, strangulated hernia, and perforated or bleeding gastric and duodenal ulcers. The traumatic department deals with such cases as non-ambulatory fractures, severe injuries, burns, and certain attempted suicides. To the medical department are brought all cases of acute pneumonia, acute nephritis, renal colic, and attempted suicide by poisoning. In the gynæcological department a very large number of cases of extra-uterine pregnancy are operated upon. In the polyclinic only one attendance is allowed, after which the patient returns to his own doctor or to the hospital in his district. The most usual cases are minor accidents, ambulatory fractures, and a wide assortment of swallowed or inhaled foreign bodies. A very large number of these are dealt with annually, and it is claimed that more foreign bodies have been removed from the œsophagus and air-passages in this out-patient department since its establishment than in any other single institution in the world.

There is also a large and almost completed pathological block, which includes an X-ray room for the examination of cadavers, and a special section to be devoted to hæmatology, with rooms and equipment for the collection and storage of cadaver blood. Here, too, are brought all cases of death and collapse in the streets or in public buildings. In Moscow these amount to about 14 per cent of all sudden deaths. This large supply of healthy cadaver material has enabled Prof. Judine to be independent of other sources of blood for transfusion purposes.

The features of particular interest to an English surgeon at the Sklifassovsky Institute are: (1) The organization of the surgical emergency service; (2) The collection, storage, and use of cadaver blood; (3) The gastric surgery of Prof. Judine.

ACCIDENTS AND GENERAL SURGICAL EMERGENCIES

The Moscow district is served by five emergency motor ambulance stations. One of these is centrally placed, at the Sklifassovsky Institute itself, where there is a large telephone bureau. Here urgent calls from all parts of Moscow are received throughout the day and night, and this station is responsible for sending out ambulances for both accidents and sudden serious cases of illness. The other four stations are situated at strategic points nearer to the periphery of the city. At each station there is a doctor on duty for the day, who is accompanied in the ambulance by two male nurses. There are two types of ambulance service. The first is the immediately urgent, for street accidents, disasters in factories, sudden sickness in public places, and so forth. In such cases a first-aid ambulance car is sent immediately, on the average one and a half to three minutes after the call is received. This type of ambulance is also sent when a call comes from a doctor who gives his name and states definitely a diagnosis such as perforated ulcer, peritonitis, or ruptured extra-uterine pregnancy. If, on the other hand, a call is made by relatives or strangers, and if the case sounds sufficiently convincing but is clearly not so urgent, the second type of service is utilized. Such cases have to wait their turn for a car, which is usually sent half an hour to one and a half hours after the call is received. In all cases which, in the opinion of the doctor on telephone duty at the Institute, cannot be considered to come under the 'urgent' category, the station recommends that doctors of the district in which the patient lives should be called, and gives their telephone numbers and the address of the nearest hospital. The two types of ambulance are painted in different colours, yellow or blue, and are well known to the police and the public, and so are easily recognized in the streets.

Suppose that an accident happens, or a case of sudden serious illness develops, in a Moscow district. First of all someone—a relative or doctor if the patient is at home, and a policeman or onlooker if the patient has an accident or collapses in the street—rings up the Central Emergency Hospital. The doctor on duty answers and has the difficult task of deciding whether a car should be sent. Fatal errors are possible, but long years of practice have made it possible to elaborate a whole series of leading questions and other means of checking and clarifying the data in these telephone diagnoses. As soon as the sending of 'emergency aid' has been decided upon, light and bell signals are given to the chauffeurs in the garage, to the doctors whose turn it is to go out, and to a hospital orderly. A second orderly is always close to the senior doctor on duty in the telephone bureau to take the written order with the address. By the time he reaches the ambulance with these data everybody else is ready in the car.

If the case is within a reasonable distance of the Institute, an ambulance is sent out forthwith from there. If it is farther away, the nearest of the four subsidiary ambulance stations is rung up from the central office and directed to bring the case in. If the case is in a district very far from the Sklifassovsky it is sometimes taken to the nearest hospital, unless it is a very unusual emergency, such as a stab wound of the heart, when it is brought to the centre, where the necessary surgical experience of rare injuries is more likely to be available.

In 1936 a total of 14,208 patients were admitted to the clinics. Of these, 3988 were surgical and 3183 traumatic. In nine years of work up to the end of 1936, there were over 6000 operations for acute appendicitis, over 2000 for strangulated hernia, about 1000 cases of acute intestinal obstruction, 4000 ruptured ectopic gestations, nearly 1400 perforated peptic ulcers of the stomach, and nearly 500 cases of profuse gastric and duodenal hæmorrhage. These enormous figures give some idea of the special experience which the surgeons at this hospital gain.

CADAVER BLOOD

Dr. Skundina, the senior woman assistant on Prof. Judine's staff, made the observation several years ago that the blood of healthy individuals who died suddenly —for instance, as a result of electrocution, coronary thrombosis, cerebral hæmorrhage, or traffic accident—coagulated rapidly after withdrawal and then reliquefied within ½–1½ hours and remained fluid. No satisfactory explanation of this phenomenon has yet been given.

Prof. Shamov, of Kharkov, originally suggested the possibility of using cadaver blood for transfusion work, but owing to the scarcity of suitable cadaver material at his own hospital he was unable to carry this idea into practice. At the Sklifassovsky Institute there is a great deal of good cadaver material—i.e., healthy adults meeting with sudden death. At the same time there is an unusual demand for blood transfusion. A misconception which must be adjusted is that cadaver blood is extensively used throughout the Soviet Union. This is not so, because only under unusual conditions does the average hospital have sufficient cadaver material to be able to rely upon this source alone. Only the peculiar and special constitution of the Central Emergency Hospital makes it possible to use cadaver blood almost exclusively, and even this hospital has sometimes had to call upon the Central Blood Transfusion Institute for a donor.

The Hæmatological Department, to which the cadavers are brought, is at present situated in the basement of the hospital, but will shortly be transferred to the new pathological block, where a special section has been set aside for this work. The cadaver blood collected is used exclusively for patients in the Institute and is not distributed to other hospitals in Moscow, which are supplied by the Central Blood Transfusion Institute.

Technique of Collection.—The technique was shown to me by Dr. Skundina. The cadavers are kept in a cool room, and the blood is withdrawn within eight hours of death in winter and six hours in summer.

The neck is prepared as for a surgical operation and sterile towels are applied after preparation of the skin. Instruments, ligatures, and cannulas are taken from a sterile drum. A two-inch incision is made along the middle of the posterior border of the sternomastoid; the internal jugular vein is exposed and two ligatures are

passed behind it and drawn to the extremities of the wound. The vein is opened by scissors in two places, first above and then below. A gaff-shaped cannula is inserted into the upper end and a straighter cannula below, and both are tied in. The high Trendelenburg position is now adopted and about 1½ to 2 litres of blood are drained from each cannula. A separate bottle of blood is collected for Wassermann reaction, grouping, and blood examination. No citrate or other anti-coagulant is added to the blood, which remains fluid after withdrawal. The bottle necks are closed with sterile gauze caps; each bottle is labelled with the date and autopsy number and placed in the refrigerator at 3° C. It is kept or discarded according to the result of the autopsy made by the pathologist, and is re-labelled as soon as the hæmatological report is received.

Cadaver blood is used up to and including the tenth day. It is sometimes used after longer storage, but not from choice, as the fragility of the red cells increases markedly after the tenth day and hæmolysis results. A slight degree of hæmolysis is not a contra-indication to using the blood, and I saw a transfusion of hæmolysed tenth-day blood given without any reaction. In practice, however, in a large hospital with a constant demand for blood transfusion the conserved blood is generally used within a few days.

GASTRIC SURGERY

Prof. Judine is in charge of the general surgical cases, though no longer of the traumatic clinic. He is particularly interested in the operative treatment of perforated and bleeding ulcers, and in reconstructive operations for complete œsophageal stricture. In over 80 per cent of cases of *perforated peptic ulcer* he practises a primary resection. The condition of the patient decides whether a resection shall or shall not be done; it has usually been found possible in the first six hours after perforation, and sometimes later. It is done under local anæsthesia and is not usually technically difficult, because an ulcer which perforates openly into the general peritoneal cavity has not as a rule formed adhesions. The operation is usually completed by an anastomosis of the gastric stump to the duodenum (Billroth I). Prof. Judine claims that the radical operation is very much better than simple suture plus gastro-enterostomy,* from the points of view both of general mortality and of recurrence. In 1933 and 1934 a total of 418 perforated peptic ulcers were operated upon: 331 had a primary resection, 35 had suture plus gastro-enterostomy, and 52 suture only. The mortality for the resection cases was 7·8 per cent, for the more conservative operations 32·2 per cent—giving a total operative mortality of 12·9 per cent.†

Bleeding Peptic Ulcer.—Prof. Judine's views on this vexed question are emphatic. He believes in and practises primary gastric resection as soon as the patient will stand the operation, provided that he has reasonable evidence that an ulcer is present and that the bleeding is not due to some other cause. This he assumes on definite X-ray evidence, a history of repeated, even though negative, X-ray

* Suture plus gastro-enterostomy is apparently a frequent alternative surgical treatment in Russia. A full account of Prof. Judine's views is to be found in *Surgery, Gynecology and Obstetrics*, 1937, lxiv, 63.

† Clearly, therefore, only the most favourable cases were subjected to partial gastrectomy.

examinations, or a clinical history suggesting ulcer over a period of time. A drip transfusion is started before the operation and continued throughout anæsthesia. Since adopting this method of transfusion as a routine he has not lost a single patient in his last 30 primary resections of the stomach for bleeding ulcer.

Reconstructive Operations on the Œsophagus.—A large number of persons in Moscow attempt suicide by swallowing strong acids and alkalis. Since these are all brought to the Central Emergency Hospital, a unique number of complete œsophageal strictures has gradually been collected. The first step, of course, is a gastrostomy, and this is followed by an œsophagostomy. Later, by a plastic operation, a skin-tube is formed on the front of the chest and a loop of jejunum is brought through it, a Roux type of anastomosis being made with the distal part of the jejunum to re-form the continuity of the tract. In this way a Pavlov type of gastric fistula is produced in which the secretions can be studied uncontaminated by food. I saw the end-results of 5 such cases in the Hospital, and they appeared to me to be very satisfactory.

SHORT NOTES OF RARE OR OBSCURE CASES

PROGRESSIVE POST-OPERATIVE GANGRENE OF THE SKIN: RECOVERY WITHOUT OPERATION

By CECIL P. G. WAKELEY and F. WILFRED WILLWAY, London

The following case is considered worthy of report, in spite of the recent rather full articles on this subject, in view of the fact that it terminated by healing without resection of the edges. Stewart-Wallace gave a very full summary of the condition in this Journal in 1934, and it is not proposed to re-emphasize his findings, the main object of the communication being to establish the fact that spontaneous resolution can occur. In his summary Stewart-Wallace emphasizes that the only effective treatment is excision of the advancing edges of the gangrenous lesions. He states that failure to carry out this effective treatment may lead to the death of the patient, or months, even years, of pain and suffering. In the case we record spontaneous healing took place in a period of seventeen weeks. It may be argued at the outset that the case recorded is not one of progressive post-operative gangrene at all. Consideration of the culture reports, the clinical course (evidenced by the photographs supplied), and the absence of marked systemic reaction, appear to eliminate the other possible diagnoses which were all duly considered. To take these *seriatim*:—

Streptococcal Wound Infection (*Hæmolytic or Non-hæmolytic*) *or Erysipelas.*—The repeated failure to obtain these organisms from the skin edge in anything approaching pure culture would appear to rule out this possibility. The well-known gangrenous form of erysipelas was considered, but excluded because of the slow nature of spread.

Gas Gangrene.—Neither the appearance nor the bacteriological findings would support this diagnosis.

Ecthyma Gangrenosum.—This possible diagnosis is only commonly found in children in previously poor health. Our patient was in excellent general health prior to the operation. The adult cases described by Brunsting were all debilitated by such diseases as ulcerative colitis before the operation which was followed by gangrene.

Infection with Specific Organisms.—The tubercle and diptheria bacillus, the actinomycosis group, the Leishman-Donovan bodies, and the virus of lymphogranuloma inguinale were considered as possible causes, but rejected on clinical or pathological grounds. There was no evidence of amœbiasis cutis, a cause reported by Heinberger. The infections similar to Vincent's angina due to the fusiform bacillus and spirillum, which have been described in other areas than the fauces, are of a different clinical type to the case we report.

R. G., aged 67, a married woman, attended on account of attacks of severe right-sided subcostal pain. She had five attacks in six months, all of which had

to be relieved by injections of morphia. The pain is colicky in nature and accompanied by vomiting. She was not jaundiced after the attack. For three years she had suffered from indigestion and flatulence. Examination revealed an obese woman in fair condition for her age. She was definitely tender over the gall-bladder. A diagnosis of cholecystitis was made and confirmed by a cholecystogram.

On June 12, 1936, cholecystectomy was performed through a right paramedian incision. The gall-bladder contained numerous stones and the wall was definitely inflamed. The appendix was also removed. The appendix was bound down and the incision had to be elongated slightly to give access to the organ. The patient was returned to bed in good condition after 40 minutes in the theatre. A gauze and rubber drain was left in the upper end of the incision, following our

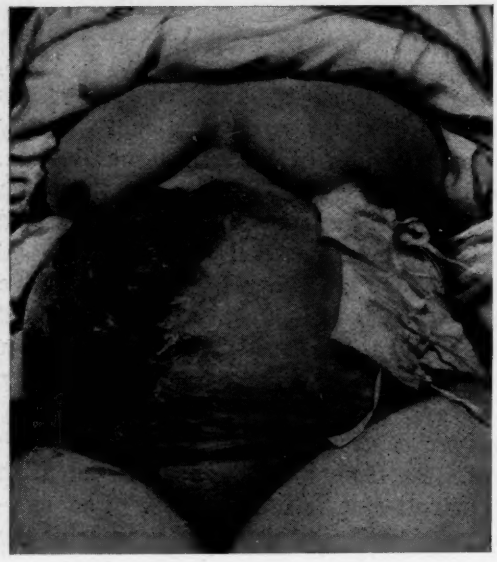


FIG. 312.—June 25, 1936. Twelfth day after the operation. Gangrene clearly present.

FIG. 313.—July 3. Twentieth post-operative day. Gangrene still spreading.

customary procedure. There were no peculiar features detected about the patient and the operation was not untoward in any manner.

For two days following the operation the patient's condition was in no way abnormal, but on the third day the temperature rose to 102°, and an inflamed area at the lower part of the incision, a hand's breadth in extent, was observed. The area was raised and covered with vesicles. A day later the patient was extremely uncomfortable, and the wound was noted to be discharging a thin sero-purulent fluid. The following morning a gangrenous patch was observed. Ten days later retention of urine occurred which lasted for no less than six weeks, the patient requiring catheterization twice daily. A foul cystitis developed during this period, though only the *Sta. albus* could be cultured from the urine and no organisms could be seen in direct smears. The urine contained a heavy deposit of pus cells. During this period the gangrenous area gradually extended (*Fig.* 312). While at first it was confined to the area of the paramedian incision and was thought

to be a burst abdomen following a mixed infection, the gangrenous nature later became evident, and the gangrene spread over the lower part of the abdomen down to the pubis, towards the right iliac fossa, and across the middle line (*Fig.* 313). During this period the ordinary therapeutic measures had been employed, including injections of anti-gas-gangrene, anti-erysipelas, and anti-scarlatina serum, with little effect. The illustrations show the extent of the gangrene on the various occasions.

The usual remedies for infected abdominal wounds were tried, without much apparent benefit. The wound, however, on Aug. 9, some five-and-a-half weeks after the operation, began to show a regression of the gangrene. The gangrenous patches commenced to separate and the wound to heal. After this, healing was steady, though slow. It is noteworthy that from this time on the urine began to

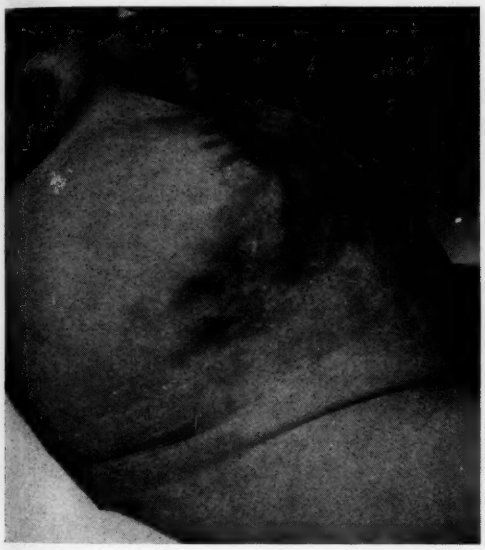


FIG. 314.—Sept. 26. Wound soundly healed seventeen weeks after the operation.

FIG. 315.—Jan. 29, 1937. Four months after discharge. Wound remained healed; some bulging at scar.

clear and the patient's general health markedly improved. No special treatment was carried out, and on Sept. 27 the wound had healed and the patient was discharged (*Fig.* 314).

It is of interest to mention that the lady was a private patient, thus negativing any possibility of previous malnutrition as an aetiological factor. She was re-examined four months after her discharge. The wound was soundly healed and there was no definite hernia, though some bulging is evident (*Fig.* 315).

REFERENCES

HICKEN, N. F., *Arch. of Surg.*, 1935, xxxi, 253.
HORSLEY, J. S., *Ibid.*, 1929, xix, 881.
MELENEY, F. L., *Surg. Gynecol. and Obst.*, 1933, lvi, 847.
STEWART-WALLACE, A. M., *Brit. Jour. Surg.*, 1935, xxii, 642.
SYME and BRYCE, *Roy. Melb. Hosp. Clin. Rep.*, 1936, vii, 108.

STRANGULATION OF A RIGHT INGUINAL HERNIA CONTAINING PART OF THE STOMACH, WITH SIMULTANEOUS PERFORATION OF A GASTRIC ULCER

By A. R. H. OAKLEY, Stafford

L. G., a man aged 81 years, was admitted at 2 a.m. on a Wednesday morning, complaining of pain in a large inguinal hernia.

History.—He first noticed the pain—which was generalized in the hernia—the previous evening. He wished to vomit, but was unable to. The bowels had

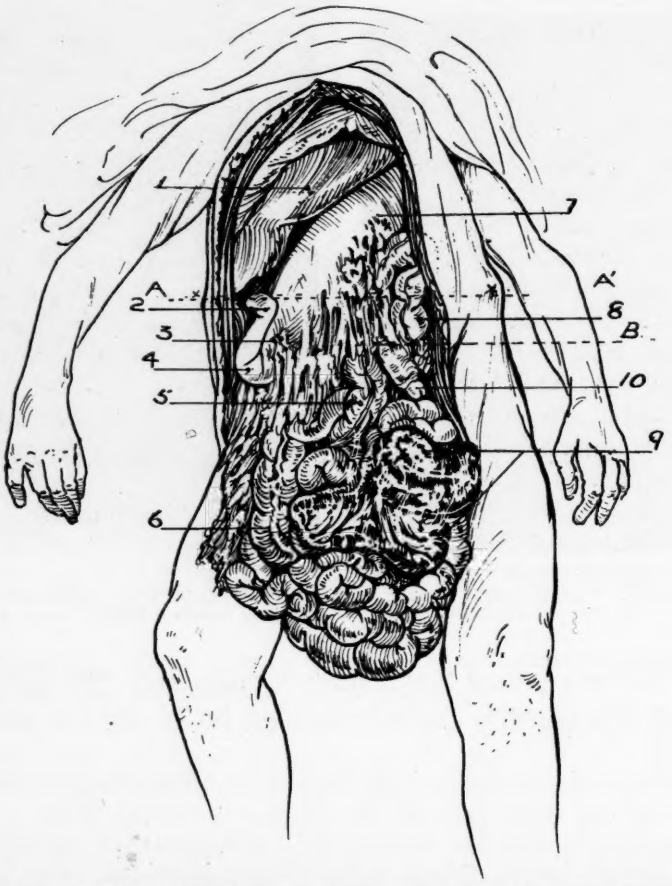


Fig. 316.—Drawing showing the extent of the hernial sac and the position of its contents. 1, Liver; 2, Pylorus; 3, Site of gastric perforation; 4, Lowest point of stomach; 5, Transverse colon; 6, Cæcum; 7, Fundus of stomach; 8, Descending colon, partly in small left inguinal hernia; 9, Lymphatic exudate binding gangrenous coils of jejunum and ileum; 10, Glans penis. AA¹ represents the line joining the anterior superior iliac spines; B, Symphysis pubis.

acted three times that day, and had always been regular. The hernia had been present for at least forty years, and its present size for the last fifteen years. He had never worn a truss, and the hernia had caused no particular discomfort. He was

walking about the day previous to admission, and felt quite well. There had been no sudden increase in size of the hernia.

CLINICAL FINDINGS.—There was a large hernia reaching to the knees. There was no marked tenderness, no visible peristalsis. The external genitalia were invisible—the external urethral orifice being represented by a sulcus on the anterior aspect of the hernia. Micturition had been 'fairly easy'.

TREATMENT.—Morphia was given, and he appeared to settle down. The bowels were not opened. Thursday midday he complained of pain in the hernia, commenced vomiting slightly, and the hernia became more tender. Operation was decided on, a diagnosis of strangulation of the small intestine being made. Before the operation was performed—about half an hour after the decision had been made—he complained of sudden, acute pain on the right side of the hernia and abdomen and commenced vomiting. He was collapsed; the abdomen was rigid and the right border of the hernia very tender.

OPERATION.—Under spinal anæsthesia a right inguinal incision was made and the sac opened, allowing blood-stained fluid and gastric contents to escape. A perforated gastric ulcer was present, $\frac{1}{4}$ in. in diameter, on the lesser curve of the pyloric end of the stomach, which occupied the neck of the hernial sac. The perforation and incision were closed. The patient died on the Friday at 1 a.m., forty-eight hours after admission.

POST-MORTEM EXAMINATION (*Fig.* 316).—There was a right inguinal hernia extending to the knees. The contents were the pyloric third of the stomach, the small intestine, the cæcum, transverse colon, part of the descending colon, and the greater omentum. The mesentery of the small intestine was compressed and twisted at the neck of the sac, and the veins were thrombosed. The intestine was gangrenous and the coils matted together by lymphatic exudate. The colon was normal. Six inches of the iliac colon entered a small left inguinal hernia, but there was no obstruction. The pancreas, liver, gall-bladder, kidneys, and urinary bladder were in their normal position. The penis was normal, the skin having been pulled to the corona forming a hood, the base of which opened on the surface of the hernia. Both testicles were present and appeared normal.

Summary.—The case exhibited :—

1. Torsion and thrombosis of the jejuno-ileac mesentery.
2. Perforation of a gastric ulcer.
3. Right inguinal hernia containing almost all the abdominal alimentary tract.

A RARE INJURY OF THE CLAVICLE

BY R. SALISBURY WOODS, CAMBRIDGE

HISTORY.—On Jan. 25, 1937, G. W. M., a medical student at Cambridge, in the course of his duties as a College 'scrum-half', fell on the ball to stop a rush, landing on the point of his shoulder.

He found that in addition to pain over the outer end of the collar-bone, he was unable to pass the ball properly owing to lack of power and precision. He continued to try for fifteen minutes, but was useless to his side, and so went off the field.

ON EXAMINATION.—At 6 p.m. there was diffuse swelling and marked tenderness over the junction of the middle two-thirds and outer one-third of the right clavicle. The arm could be raised, but pain resulted.

DIAGNOSIS.—

Provisional.—Pending X-ray examination, it seemed that he must have a fissure fracture, held in perfect position by the conoid and trapezoid ligaments, though with remarkably little disability.

Actual.—X-ray examination, however, revealed no complete fracture of the clavicle, but an *avulsion of the bony attachment of the conoid ligament* to the inferior surface of the clavicle (*Fig.* 317). The detached fragment was about 0·5 cm. in diameter.

TREATMENT.—The injured region was supported by a band of Elastoplast, passing diagonally upwards and outwards from the inferior angle of the opposite (left) scapula, over the injured (right) clavicle, looping the axilla, and finishing diagonally downwards and forwards to the left hypochondrium. The support was completed by three vertical 2 in. strips of strapping from behind forwards over the clavicle in an overlapping manner.*

FIG. 317.—Antero-posterior view showing avulsion of clavicular attachment of conoid ligament.

The limb was rested in a sling for a few days, but used for dressing and feeding, to avoid stiffness and atrophy.

Course.—Jan. 30: Swelling has subsided considerably. Patient ran about and practised 'passing' gently. Strapping omitted, sling only.

Feb. 8: No swelling. Training daily (passing, etc.). Feels thoroughly fit.

Feb. 16, *three weeks after his injury: Played in a Cup match as a scrum-half* (*where accurate passing is essential*), and did not feel the shoulder, either in tackling or in giving passes.

Feb. 18: Further X-ray report states: "It seems that one can still see the flake, much decalcified, and in the substance of the ligament." Clavicle clinically normal. All movements of shoulder-joint full, free, and painless. Complete recovery.

Comment.—I can find no mention of avulsion of the clavicular attachment of the conoid ligament in any of the text-books.

I discussed the case with Professor H. A. Harris, in charge of the University Anatomy Department here, and although he too had not actually seen a case, he recalled three bodies, in dissecting rooms, in which the conoid ligament was ossified. He put forward the interesting suggestion that such ossification was most probably the end-result in neglected cases of the injury just described.

This probability is increased by the condition shown by the X-ray examination after three weeks.

---

* Method for fracture of clavicle, published fully in C. P. G. Wakeley's *Modern Treatment in General Practice*, Vol. II., "The Treatment of Athletic Injuries", by R. Salisbury Woods, 1935.

OSTEOCHONDRITIS OF THE VERTEBRAL BODY (CALVÉ'S DISEASE)

By ALEX. DALE

SURGEON, MEARNSKIRK HOSPITAL, GLASGOW

OSTEOCHONDRITIS of the vertebral body was first described as a definite radio-clinical entity by Jacques Calvé of Berck when he addressed the meeting of the British Orthopædic Association at Bologna in September, 1924.[1] Four years later Calvé collected 9 cases which had been observed by various workers, and discussed the aetiology of the condition.[2] In 1935 Sundt[3] made a critical review of 21 cases, some of a doubtful nature, recorded in the world literature up to that date, and reported 2 further cases. The condition, which closely simulates Pott's disease in its clinical aspect, but can be differentiated by the characteristic radiographic appearances, would seem to be of sufficient rarity and interest to justify the following report of a case which has been under observation for four years.

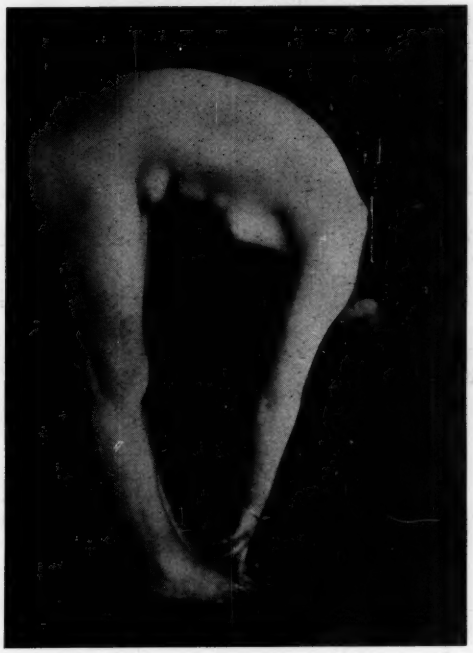


FIG. 318.—Patient on Feb. 22, 1937. No deformity. Full flexion of spine.

M. A., a girl, 10 years of age, was admitted to hospital on June 29, 1933, as a case of Pott's disease, the diagnosis having been made following radiological examination. She gave the story that for six weeks she had suffered from pain in her left side, first on walking, but later even on sitting. The onset of her complaint was not immediately preceded by injury or illness. The history of an injury, which had occurred seven years previously, when she had been knocked down by a tramcar, was recorded. She had suffered only from the common ailments of childhood, measles and whooping-cough at three years of age, and chicken-pox in her eighth year, being particularly specified. There was no personal or family history of tuberculosis, and her tuberculin reaction (Mantoux) was negative. The Wassermann reaction was also negative.

On admission to hospital she was found to be well nourished and in good general health. She walked with the body held stiffly and bent somewhat to the left. There was marked spinal rigidity, with deviation of the spine to the left above a small gibbosity in the lower dorsal region. Tenderness was elicited on percussion over the 8th, 9th, and 10th dorsal spines. No abscess could be palpated, and there was no evidence of compression of the spinal cord.

The local and general treatment applicable in Pott's disease was instituted, and she responded well, putting on two stones in weight during two years' residence in hospital. Apart from an attack of tonsillitis her progress was uninterrupted. For the first year the spine was immobilized and slightly hyper-extended on a spinal carriage. Tenderness soon disappeared, and at the end of a year no deformity could be detected. She was at that stage allowed up in a plaster jacket, and before her dismissal on July 28, 1935, the spinal mobility was free. For one year after leaving hospital a celluloid spinal jacket was worn.

On examination in February, 1937, no clinical abnormality could be detected in the spine. There was no deformity. Spinal mobility was free and full in every direction. She had no difficulty in touching her toes and holding the position for photography (*Fig.* 318). She was going about all day helping in household duties and was seeking employment in domestic service.

FIG. 319.—Radiograph of spine, July 19, 1933. Lateral view. Reduction of a single vertebral body (D.V. 9) to a thin disc of increased density.

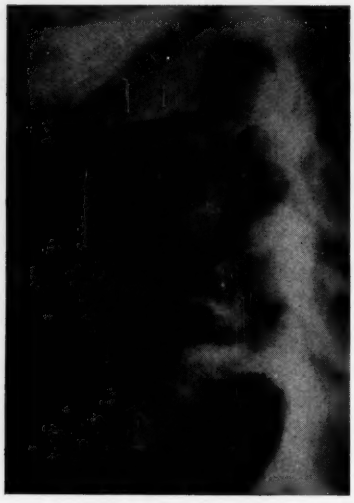


FIG. 320.—Radiograph of spine, Dec. 16, 1936. Lateral view. Partial regeneration of vertebral body (D.V. 9). No loss of intervertebral discs.

RADIOLOGICAL APPEARANCES.—Radiographs demonstrated the features characteristic of the lesion described by Calvé, namely: (1) Only one vertebra involved—the 9th dorsal; (2) Reduction of the vertebral body to a plano-parallel disc; (3) Increased density of the bone shadow; (4) Integrity of the intervertebral discs above and below the affected body; and (5) Partial regeneration of the vertebral body.

In *Fig.* 319, which is from a film taken on July 19, 1933, nine weeks after the onset of symptoms, features (1) (2) and (3) are well shown. The other features are demonstrated in *Fig.* 320, which is from a film taken on Dec. 16, 1936. Intermediate radiograms showed gradual regeneration of the vertebral body. This regeneration, the implication of one vertebra only, and the almost complete escape of the intervertebral discs, are the features most helpful in distinguishing the disease from tuberculous caries.

Comment.—A case is recorded in which the original diagnosis of Pott's disease was reconsidered and altered in the light of the progress made under treatment and the unusual features presented in successive radiograms. In these respects the course of the disease was similar to that observed in the cases first described by Calvé under the heading "osteochondritis of the vertebral body".

In adding this single case to the literature on Calvé's disease it is not my purpose to enter on a general discussion of the aetiology of this rather uncommon condition. I might, however, be permitted the following remarks. Although the radiographic picture is quite distinct from that usually associated with Pott's disease, and although in the case here recorded, and in others, tuberculosis can be excluded in view of the negative tuberculin reaction, it does not follow that tuberculosis may not in some cases be responsible for the peculiar radiographic appearances described. Two other conditions usually grouped with Calvé's disease under the heading osteochondritis deformans juvenilis, namely, Perthes' disease and Köhler's disease of the tarsal scaphoid, might be included in this remark. I have had under observation a case diagnosed on radiographic evidence as Köhler's disease, in which abscess and sinus formation occurred. From scrapings removed at operation tubercle bacilli were grown in culture. Similar experiences have been recorded by others. It is possible that a variety of mild infective agents, including the tubercle bacillus, may in different cases be responsible for the characteristic radiographic appearances seen in these allied conditions. I believe this to be true of Köhler's disease, and feel that suspicion may justifiably be extended to other like conditions.

I have to thank Dr. Fergus L. Henderson for the radiographs which accompany this report.

REFERENCES

[1] CALVÉ, JACQUES, *Jour. Bone and Joint Surg.*, 1925, vii, 41.
[2] CALVÉ, JACQUES, *The Robert Jones Birthday Volume*, 1928, 315. Oxford Medical Publications.
[3] SUNDT, H., *Acta chir. Scand.*, 1935, lxxvi, 501.

AN UNUSUAL CAUSE OF PULSATING EXOPHTHALMOS

BY P. BARON
RESIDENT SURGICAL OFFICER, NORFOLK AND NORWICH HOSPITAL

J. M., aged 10½ years, was admitted to the Norfolk and Norwich Hospital on April 17, 1937.

HISTORY.—This was obtained from his parents on his admission, and completed by the evidence of an eye-witness of the accident, at the inquest.

He had been riding a bicycle too large for him, and had fallen off. In falling, the brake handle, on the handle-bars, had struck him over the right upper eyelid. He was dazed immediately after the accident, but did not lose consciousness. He was taken to his home near the Hospital, and from there he walked into Casualty with his parents.

EXAMINATION.—On admission he was very pale and shocked. His pulse-rate was 90, and was of low tension. He was drowsy, but irritable when roused, when he replied rationally to any question put to him. The only obvious injury was a large hæmatoma of the right upper eyelid. This made it impossible for us to examine his right eye, so he was anæsthetized with ethyl chloride and the eye examined. It was found to be perfectly normal in every way. There was no objective evidence of a fractured skull, nor was there any fracture apparent on radiography.

SUBSEQUENT COURSE.—He vomited, for the first time, shortly after admission. About six hours later he lapsed into a coma, from which he could be roused only with difficulty. When roused he would take his feed, leaving the last mouthful unswallowed, and pass into a coma again until roused for his next feed. The reflexes remained normal throughout.

The following morning it was noticed that his right eye was proptosed, forcing the lids open to the extent of about an eighth of an inch. This proptosis steadily increased, and had reached an advanced stage twenty-four hours later, when regular pulsation of the eye was noted. A lumbar puncture at this stage revealed the cerebrospinal fluid to be under increased tension and to contain blood. On the assumption that the condition was due to an injury of the intracranial portion of the internal carotid artery or of its ophthalmic branch, a general anæsthetic was given and the artery was exposed in the neck and ligatured. This procedure had no immediate beneficial effect on the eye, the pulsation persisting for about another twelve hours, after which it ceased and did not recur.

The general condition of the boy steadily deteriorated. It became increasingly difficult to rouse him, and he died on May 2. The proptosis persisted until his death.

POST-MORTEM FINDINGS.—There was a fracture of the anterior cranial fossa present, localized to the superior wall of the right orbit. The bone in that region had been splintered and driven into the overlying brain, leaving a gap about the size of a sixpenny piece in the orbital wall. Through this opening the brain had herniated, pushing the periosteum and globe before it. The overlying brain was softened and degenerated. There was no retro-orbital hæmatoma, nor was there any evidence of disease or injury elsewhere in the body.

Conclusions.—The cause of the pulsating exophthalmos was a hernia of the brain into the right orbit. As the intracranial tension increased, due to the associated contusion of the brain, more brain was forced through the opening in the superior orbital wall, accounting for the advancing proptosis. The pulsation was the normal cerebral pulsation transmitted to the eye, and presumably ceased when the gap in the bone was completely sealed off by the brain.

An unusual feature of this case is the absence of any marked external manifestation as compared with the extensive internal injury. Apparently the blunt end of the brake handle had pushed the upper eyelid in front of it, without lacerating or bruising it, and had caused a localized fracture of the anterior cranial fossa.

I wish to thank Mr. A. J. Blaxland, Senior Surgeon to the Norfolk and Norwich Hospital, and Mr. G. Maxted, Surgeon to the Eye Infirmary, for their permission to publish this case.

A CASE OF MULTIPLE THORACIC INJURIES IN ROMAN BRITAIN

By R. S. HANDLEY

THE ANATOMY SCHOOLS, CAMBRIDGE UNIVERSITY

SERIOUS crushing accidents of the thorax are apt to be regarded solely as the heritage of our modern mechanical era. That this is not so is proved by the recent discovery of a skeleton dating from the Roman occupation of Britain which shows a chest injury comprising sixteen fractures of the ribs and one of the clavicle; and that all the fractures are soundly healed shows that primitive medicine was equal to the occasion.

The archæological and anthropological aspects of the discovery have been dealt with by Keith and Ward.[1] Briefly, the skeleton was found in a stone coffin

FIG. 321.—The first ribs and manubrium sterni, seen from behind.

at the village of Snodland, Kent, and the available evidence points to the fourth century A.D. as the date of burial. Pottery, coins, and the remains of a tesselated pavement, all of Roman origin, have been discovered hard by, and the design and disposition of the coffin accord with Roman custom.

The patient was a man about 5 ft. 6 in. in height and about 36 years of age. He was right-handed and of robust build. Except for slight lipping of the lumbar vertebræ, his bones outside the thorax present no abnormality, and, as is common in bones found in Roman camps, the only feature by which he can be distinguished from the modern stocky Englishman is the beautiful condition of his teeth. There is nothing to indicate the final cause of death.

A double row of fractures, so regular that they must all have been received at the same time, runs down the thorax, nearer the tubercles of the ribs on the right side than on the left. The first ribs have suffered severely, the right one being fractured immediately lateral to the tubercle, and the left showing extensive crushing, with subsequent calcification and ossification, of its costal cartilages (*Fig.* 321); the first right costal cartilage shows a ridge suggestive of slight injury. The right fourth, fifth, and sixth ribs (*Fig.* 322) are extremely interesting, in that comminution in this region must have been considerable, and the fractures in uniting have thrown bars of callus across the two related intercostal spaces, and thereby given the chest such rigidity that costal respiration must have

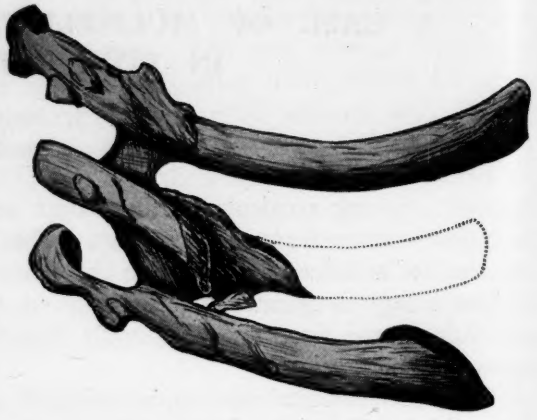


FIG. 322.—The right fourth, fifth, and sixth ribs, seen from the right side.

SITES OF FRACTURE

BONE	RIGHT SIDE	LEFT SIDE
Clavicle	Middle of shaft	Intact
1st rib	½ in. anterior to tubercle; ? crush of costal cartilage	At costochondral junction
2nd rib	Missing	Missing
3rd rib	2 in. anterior to tubercle	4½ in. anterior to tubercle; at costo-chondral junction
4th rib	1 in. anterior to tubercle	3 in. anterior to tubercle
5th rib	1 in. anterior to tubercle	3½ in. anterior to tubercle
6th rib	4½ in. anterior to tubercle	4 in. anterior to tubercle
7th rib	Intact	3⅛ in. anterior to tubercle
8th rib	4 in. anterior to tubercle	3½ in. anterior to tubercle
9th rib	Intact	3½ in. anterior to tubercle
10th rib	Intact	4 in. anterior to tubercle
11th rib	Intact	Intact
12th rib	Intact	Intact

been severely limited on the right side. A drawing of the specimen shows that the bar uniting the fifth and sixth ribs has joined the latter well behind its own

site of fracture. I have discovered only one reference to this method of union in the literature.[2] The positions of fracture of the ribs are summarized in the table on the previous page.

The thoracic spine between the sixth and tenth vertebræ shows changes associated with severe injury to the ligaments. These vertebræ are joined to one another by ossification in the short intervertebral ligaments of the right side (*Fig.* 323). Their appearance and distribution bear out the conclusions of Shore's[3] paper on osteo-arthritis of the spine. The costovertebral ligaments in this region also show ossification, so complete in the case of the eighth right rib that it is firmly fixed to the vertebræ concerned. There is nothing to suggest that dislocation of the ribs has occurred, for the costocentral joints, though deeply cupped, are in the correct position. Above the sixth and below the tenth thoracic vertebræ there is very little pathological change. A drawing of the clavicle (*Fig.* 324) shows that union took place with considerable overlap of the broken ends.

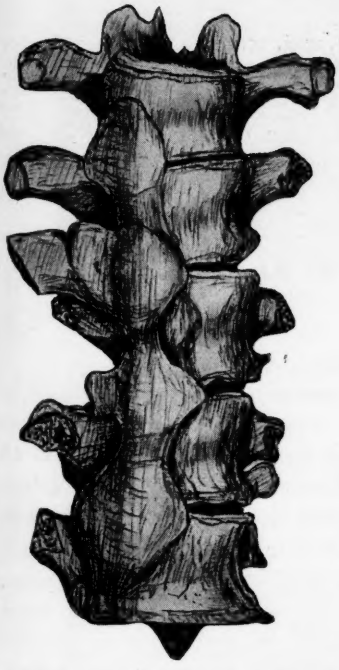


FIG. 323.—The sixth to the tenth thoracic vertebræ, seen from in front.

FIG. 324.—The right clavicle, seen from above.

Injuries such as those described can only have arisen from a severe crush. It seems likely that the force fell obliquely across the thorax, involving the right side more seriously above, the left side below. This would account for the fractured right clavicle and the fracture of the first right rib near the tubercle; for the latter can only be due to force transmitted directly along the long axis of the rib. While fractures at the anterior end of the first rib may be explained by the lever action of the suddenly depressed clavicle, such a mechanism seems unlikely in posterior fractures, where the mechanical advantage would be greatly diminished.

I have tried to find records of parallel injuries in modern times, but although cases must occur in industrial accidents, I have been unable to discover any note where such extensive bony damage was followed by recovery. Jones and Richardson[4] applied traction to the sternum of a girl of twelve who had had the second to ninth left ribs broken in a street accident and thereby relieved her when death from asphyxia appeared imminent. In 1890 Rolleston[5] showed some specimens from cases which had died from thoracic injuries: one from a man who, crushed in a lift, had suffered fracture of the upper eleven right and upper nine left ribs.

One can only speculate on the cause of the Roman's accident. Perhaps his

horse rolled on him, or a tree fell and crushed him; to the modern mind the picture of a serious chariot accident is attractive. But whatever the cause, so curious a record cannot fail to be of interest.

I have had the privilege of discussing the skeleton with Sir Arthur Keith, who kindly handed it over to me for description of the injuries. My best thanks are also due to Professor H. A. Harris for his criticisms and his help in preparing this short description. The skeleton has been deposited in the Museum of the Royal College of Surgeons of England.

REFERENCES

[1] KEITH, A., and WARD, G., *Archæologia Cantiana*, 1934, xlvi, 202.
[2] BERGMAN, E. VON, BRUNS., P. VON, and MIKULICZ, J. VON, *System of Practical Surgery*, 1904,ii, 438. London.
[3] SHORE, L. R., *Brit. Jour. Surg.*, 1935, xxii, 833, 850.
[4] JONES, T. B., and RICHARDSON, E. P., *Surg. Gynecol. and Obst.*, 1926, xlii, 283.
[5] ROLLESTON, H. D., *Trans. Pathol. Soc. Lond.*, 1891, xlii, 232.

NOTE ON TWO CASES OF KRUKENBERG'S OPERATION

BY BERNARD T. SQUIRES
BECHUANALAND PROTECTORATE MEDICAL SERVICE

SOME years ago my attention was drawn to an article by A. K. Henry[1] upon an operation for making the forearm prehensile after the loss of a hand. In this article an account is given of a method devised by Krukenberg, the object of which is to convert the radius and ulna into the two jaws of a 'crocodile' forceps. I was much impressed by this account, and determined to employ it when opportunity offered. During the last two years I have twice performed Krukenberg's operation upon native patients. The results, both immediate and remote, have been very gratifying, considering the primitive conditions under which both operation and after-treatment were carried out.

Case 1.—A native female, aged about 17, was admitted in March, 1935, with a badly mutilated left hand, due to the premature explosion of a detonator with which the girl had been playing. The accident had taken place three days before, and the wound was very septic. All the digits and the distal halves of the metacarpals had been blown away. Under treatment the septic area cleared up in about two weeks, after which disarticulation through the wrist-joint was performed. About three weeks later I performed Krukenberg's operation, as described in the article referred to above.

The patient was very small for her age, so, on account of the shortness of the forearm, the interosseous membrane was divided only for a distance sufficient to obtain a separation of 9 cm. between the ends of the radius and ulna, instead of 12 cm. as stated in the original description.

The raw area remaining after the skin closure was at first grafted as recommended by means of a pedicled flap cut from the abdomen; but owing to the ignorance and low mental level of the patient, who succeeded in pulling the forearm out of the flap, this method was abandoned, and a series of small grafts, each of 3 to 4 mm. diameter, cut from the inner side of the thigh, were applied instead. These grafts 'took' very well.

Four days after the operation, an area of pressure necrosis appeared in the skin over the end of the radius, and a small piece of this bone had to be removed. After this, recovery proceeded rapidly.

Movements were initiated as soon as healing was complete, but as there were no facilities for the application of either massage or electrical treatment, it was a month before the patient was able to re-educate her muscles sufficiently to hold a spoon. At the time when she was removed by her relations against my wish, some six weeks after operation, she was able to abduct the radial limb of the 'forceps' to an angle of 15° (*Figs.* 325, 326).

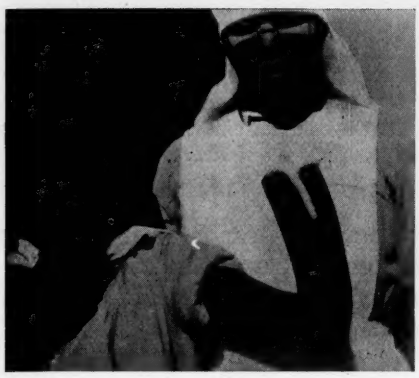


FIG. 325.—*Case* 1. 'Forceps' open.

FIG. 326.—*Case* 1. 'Forceps' closed.

I saw her again after an interval of several months, and although the maximum angle of abduction remained the same, increasing dexterity had made the 'forceps' useful for a variety of purposes, from grasping a spoon to the steadying of a hoe.

Case 2.—A native female, aged 10, was admitted in May, 1936, with a similar mutilation, also due to a detonator explosion. In this case the whole of the hand to within three-quarters of an inch of the wrist-joint had been blown off. The accident had occurred some six hours

FIG. 327.—*Case* 2. 'Forceps' open.

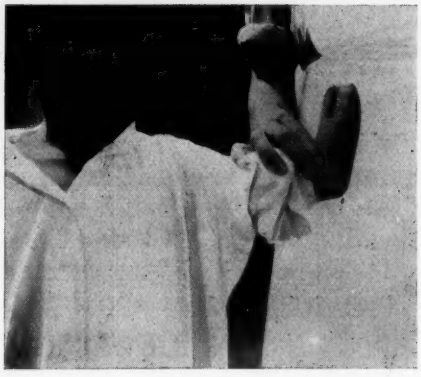


FIG. 328.—*Case* 2. 'Forceps' closed.

before admission, and treatment was instituted before any septic infection had become established. A few days later, I disarticulated the stump through the wrist-joint, and as soon as the wound was healed, again performed Krukenberg's operation.

In this case, to avoid pressure necrosis, I removed about a quarter of an inch of bone from both radius and ulna, the ends of which were separated for a distance of about 7 cm. I did not attempt to form a pedicled flap, but applied a number of small grafts, as before. The first few dressings, owing to the youth of the patient, had to be changed under general anæsthesia.

In spite of the onset of a mild septic infection after the first dressing, recovery proceeded so rapidly that three weeks after operation the patient was able to demonstrate slight 'pill rolling' movements of one jaw of the 'forceps' against the other. She was not so difficult to deal with as the first patient, and rapidly taught herself to hold a spoon, and to feed herself by means of the 'forceps'.

FIG. 329.—*Case* 2. Holding spoon.

At the time of her discharge, she also could abduct the radial limb to an angle of 15°, and was able to grip a spoon quite tightly (*Figs.* 327–329).

I saw her about four months after operation, when she was able to abduct the radial limb to 20°, and to pick up a variety of objects with the 'forceps'.

Comment.—Amongst the literature at my disposal, I have been able to find only one reference[2] to this operation; even this reference gives only few particulars.

In civilized regions, where the artifices of modern orthopædic surgery and the resources of the artificial-limb maker are at the patient's service, it may well be that there is little or no scope for Krukenberg's method; but in the circumstances under which the above patients were treated, in a small hospital far from civilization, and for the class of primitive native from which patients are drawn, I consider that this operation has a definite field of usefulness.

The only alternative for these patients would have been a useless stump, for no ordinary native could afford to buy a prosthetic appliance, nor, if he possessed one, would he keep it in good condition.

Krukenberg's operation does not involve the later use of any such appliance, nor does its performance require the use of any special instruments or technique.

I am indebted to the Principal Medical Officer of this Protectorate for permission to publish this note.

REFERENCES

[1] HENRY, A. K., *Brit. Jour. Surg.*, 1928, xvi, 188.
[2] COLT, G. H., and READING, P., Section on "Amputations", *British Encyclopædia of Medical Practice*, 1936, i, 397. Butterworth & Co.

CARCINOMA OF THE BLADDER OCCURRING IN UNUSUAL CIRCUMSTANCES

BY ALEXANDER DUFF

RESIDENT SURGICAL OFFICER, MUNICIPAL GENERAL HOSPITAL, BURNLEY

THE following is an account of a case of carcinoma of the bladder occurring in unusual circumstances, and presenting several interesting features.

A man, 59 years of age, a farmer, was admitted to hospital complaining of severe pains on micturition and also of constant pain in the lower abdomen. He said that at the age of 11 years he had had an operation for stone in the bladder at a certain provincial teaching hospital. Ever since then he had been troubled

by fæces coming per urethram with the urine, and urine per rectum with the fæces, sometimes the one, sometimes the other. Apparently no treatment had been sought and he had always been otherwise in good health. Recently he had had considerable pain on micturition, difficulty of micturition, and general deterioration of health, with latterly constant pain and discomfort.

On admission the patient was in poor condition. He had a sinus in the middle of the under surface of the penis. A probe passed into this, when directed anteriorly, went along the urethra; when directed posteriorly it apparently took a course superficial to the urethra, appearing in the anal canal on the anterior wall at a point about half an inch from the anal orifice. There was a moderate degree of phimosis.

The urine was foul, ammoniacal, and contained much pus; it could not be ascertained whether any urine was passed per rectum. Suprapubic cystostomy was performed and a De Pezzer catheter introduced, but the patient's condition deteriorated and he died five days after admission.

POST-MORTEM EXAMINATION.—The sinus in the under surface of the penis opened into the urethra at a point immediately under its external opening. It also communicated with a track leading posteriorly, superficial to the urethra, to the perineum, having an opening in the anal canal on the anterior aspect, at the upper end. There was no external opening in the perineum, but there was a faint mark which might have been the scar of a sinus or operation. There was thus a urethro-rectal fistula with an external opening of the type commonly encountered as a sequel to peri-urethral abscess.

The bladder was much thickened and contracted. Posteriorly it was inseparably adherent to the rectum, and the two organs were removed together.

A recto-vesical fistula surrounded by extremely dense fibrous tissue was present, running between the posterior part of the trigone and the anterior rectal wall; it entered the rectum about two and a half inches from the anal orifice. The interior of the track was perfectly smooth, and it was obviously of long standing. Surrounding the mouth of the fistula inside the bladder there was a raised area about one and a half inches in diameter with the characteristic cauliflower-like appearance of a carcinoma. No metastatic tumours were found.

Microscopic Examination.—The bladder round the mouth of the fistula was found to be the seat of an adenocarcinoma. The fistula itself was not malignant, but had a few masses of malignant cells in relation to it on one side only. There was also a larger malignant deposit some little distance from the fistula.

Commentary.—This is a case of adenocarcinoma of the bladder whose chief interest lies in the unusual attendant circumstances; there are also some points worthy of note in the pathological features.

1. The supervention of malignant disease in connection with chronic sinuses and fistulæ is well recognized, but I have not been able to find any record of such in the case of the bladder. The development of carcinoma in connection with ectopia vesicæ would appear to be comparable.

2. The exceedingly long period (48 years) elapsing between the establishment of the fistula and death with malignant disease.

3. The neoplasm took the form of adenocarcinoma, the least common type of carcinoma in the bladder.

4. Unfortunately details of the original surgical procedure were not available,

the records having been lost, but it seems probable that this was a perineal lithotomy, and that there had been a peri-urethral abscess at one time, leaving the fistula between penile urethra and anal canal. There was no suprapubic scar, and there was a degree of phimosis that would certainly have been dealt with before undertaking lithotrity, were an instrument suitable for a boy of 11 available at that date (1888).

The case is therefore something of a surgical curiosity. Rectovesical fistulæ following perineal lithotomy were formerly frequent, but must be rarely encountered nowadays. In addition, the early age at which operation for vesical calculus was required is of note, together with the complete freedom from any further stone formation, and the existence of a recto-vesical fistula for forty-eight years untreated.

I have to thank Dr. D. C. Lamont, Medical Superintendent of the Hospital, for permission to publish this case.

REVIEWS AND NOTICES OF BOOKS

Rose and Carless's Manual of Surgery for Students and Practitioners. By CECIL P. G. WAKELEY, D.Sc.Lond., F.R.C.S.Eng., F.R.S.Edin., Senior Surgeon, King's College Hospital, and JOHN B. HUNTER, *M.C.*, M.Chir.Cantab., F.R.C.S.Eng. Fifteenth edition, in 2 volumes. Large 8vo. Pp. 1617, with 948 illustrations, and 29 coloured plates. London: Baillière, Tindall & Cox. 30s. net.

To very many British surgeons "Rose and Carless" represents their Surgical Bible, brought out in 1898 when they were medical students, founded in Lister's school, and kept up to date year by year by Lister's successors at King's College. We give a warm welcome to this last edition, revised and partly re-written by Wakeley and Hunter. This edition, appearing in 1937, is suitably marked on the covers by effigies of their Majesties, and the crown and sceptre. It is in two volumes, which marks a new departure and makes the book much more easy to handle.

Much new matter of importance has been added. The chapter on thoracic surgery has been re-written; surgical shock and the sympathetic nervous system; surgery of the central nervous system; radium and deep X-ray therapy; and plastic surgery of the face: all represent practically new matter. The first part of the book dealing with bacteriology, inflammation, and immunity has been re-written by Dr. Carnegie Dickson, and all the special subjects—e.g., eyes, ears, orthopædics, etc.—have been revised by well-known specialists. There are 130 more pages and 242 more illustrations than in former editions.

The general principles of fracture treatment are open to some criticism. It is misleading to say that the days of prolonged immobilization are over. On the contrary the actual fractured bone must be immobilized firmly and this must be maintained till bony union has occurred. Massage for fractures near joints remains as one of the errors which must be combated. Massage and passive movements should never be used in a recent fracture—their place has been taken by active movements. In fractures of the neck of the femur it is hardly accurate to say that the technique of insertion of Smith-Petersen's nail is 'extremely difficult', or that the patient has to stay in bed three months after the operation. The opinion of Sir Henry Gauvain adverse to bone-grafting operations on the spine has now been modified, so that he recommends it for certain cases which have failed to respond to conservative treatment, even in children. Amputation in the ordinary sense of the word is not the best treatment for hypertrophy of the breast, but rather plastic reconstruction with preservation of the nipple. Justice is not done to the modern operation for cleft palate. Surely Gillies' operation has now been superseded by the modification of Veau's procedure described by Wardell and Dennis Browne.

The whole get-up of the book is excellent and the new illustrations are of great value. We are glad to get this revised version of our Bible and shall often turn to its pages for help and guidance.

Operative Surgery. By J. SHELTON HORSLEY, M.D., LL.D., F.A.C.S., Attending Surgeon, St. Elizabeth's Hospital, Richmond, Va., and ISAAC A. BIGGER, M.D., Professor of Surgery, Medical College of Virginia, Surgeon-in-Chief, Medical College of Virginia Hospitals, Richmond, Va. With contributions by C. C. COLEMAN, M.D., F.A.C.S., JOHN S. HORSLEY, jun., M.D., AUSTIN I. DODSON, M.D., F.A.C.S., and DONALD M. FAULKNER, M.D. Fourth edition. Large royal 8vo. In two volumes. Pp. 1387 + xxviii, with 1259 illustrations. 1937. London: Henry Kimpton. 63s. net.

THERE has been a large expansion of this work since the last edition of nine years ago, necessitating its division into two volumes. The pages and illustrations have each been increased by about 500. Dr. Isaac Bigger has joined Dr. J. Shelton Horsley as co-author, and they have had the assistance of four specialists to contribute the articles on the operative procedures in the central nervous system, urology, plastic surgery, and orthopædics.

The book aims at emphasizing physiological and biological principles in operative surgery. In general the balance of the subjects is good. Although many of the indications for operation are given, it would make the presentation more educational if the chief milestones in their history were chronicled, together with the reasons for their having superseded other forms of treatment. Conversely, the injection treatment of hernia is not mentioned and the subject of infantile hernia is omitted. There is an inaccurate statement on p. 738 concerning oblique hernia.

It would be an advantage to include in a future edition a chapter on anæsthesia and analgesia so that it could be referred to in any particular procedure, whereas we are treated to excellent disquisitions on the subject under stomach and plastic operations. Not everyone will agree with the probability of a gastro-enterostomy being followed by peptic ulcer in a young man with high acidity. The chapters on surgical drainage and technique are brief and to the point. The chapter on malignant tumours is stimulating. It would appear that the primary employment of radium is not sufficiently recognized for cutaneous and other very sensitive growths. For example, its known success, in expert hands, in basal-celled carcinoma and in carcinoma of the penis and lip is so great that the horrible operations of the past are seldom required to-day. Judging by the text its use seems to be still relegated to inoperable cases.

The treatment of shock is too brief. Acidosis is regarded as a late sign and warmth is to be used, but this is the only mention of heat in the prevention and treatment of shock. Gum-saline is not mentioned, whereas a whole chapter is devoted to continuous intravenous injections. The technique of arterial suture is well described, but one feels that the chance of its ever being used by the average surgeon is small. The aneurysm article is well balanced, but parts of it are many years out of date.

"No attempt should be made to expose the nerve at the site of injury until after it has been uncovered in its healthy portion, both distal and central to the injury" is not sound teaching for accident work. "It is important to isolate the nerve to no greater extent than necessary" is better. A résumé of the late results of reduction would be a good preliminary to the reconstruction operations on the hip. Tendon operations are well described and illustrated, but the methods described would take far too long, be meddlesome, and lead to sepsis if, for instance, the flexors of the wrist were cut to the bone. Tendon, nerve, and bowel suture alone in general surgery are helped by using an eyeless needle, but such is not illustrated. One would expect the two chief objections to cineplastic amputations to be stated. Devine (p. 215) should have replaced the older methods of arthrotomy. A statement of the late results of lymphangioplasty would be welcome. Babcock's extraction method for varicose veins should be described, and the serious lymphatic and nerve injuries caused by the Schede spiral incision should certainly be stated. The section on infections of the hand does not draw sufficient attention to the danger to life and limb from 'felons', nor is the spread to the joints in a dorsal infection given. Its frequency, too, is minimized. Osteomyelitis should have a separate chapter. "These patients are often quite ill." Sir Henry Gray's method of leaving Thiersch grafts exposed gives better results than any other 'dressing', but is little known. A warm moist cage should be used.

The general arrangement of the 186 pages on plastic surgery is good and the descriptions are lucid. An illustration of the lymphatics of the region should accompany the accounts of carcinoma of the facial regions and operations on the neck. The lateral operation of access for applying radium to the larynx is omitted. The operations on the chest and its contents are well described. The useful expedient of union by invagination in rectosigmoid resection is not described. Carbolic oil injections may save an operation for rectal prolapse, and the injection treatment of anal fissure now renders operation a rarity. Injecting piles with quinine in the quantities stated seems unwise. There is a good description of a fascial sling from the glutei for anal incontinence. The inguinal operation for varicocele gives better and safer results than the scrotal one described. Sliding bone-grafts have been superseded by celluloid plates for skull defects. Why? A catgut suture is safer than wiring the bone flap. The reasons for not injecting the supra-orbital nerve are not stated. Where the rest of the subject is well done it is curious to see no description of the de Pezzer tube method of suprapubic cystostomy.

A book of this kind must be difficult to plan and to write, having regard to the frequency of alterations. Its chief failures are small ones and due to the prominence of the description of technical matters. One misses the debt of surgery to the pioneers when an old

operation appears under a new name. One misses, too, the chronological sequence and reasoning that help to establish a new procedure and which fix it in the mind of the reader.

Misprints are not numerous. In the Table of Contents (vol. II) the headings of chapters 43, 50, and 54 could be better arranged. Corrections are required as follows: p. 788, line 10; p. 627, a line has been omitted about ethylene (?). *Figs.* 663, 672, 673 are not all of them necessary, whereas a diagram of gastro-enterostomy 'en-Y' would probably help to clarify this difficult mental jerk. The description of *Fig.* 1117 needs amendment.

Preoperative and Postoperative Treatment. By ROBERT L. MASON, A.B., M.D., F.A.C.S., Assistant in Surgery at the Massachusetts General Hospital. Royal 8vo. Pp. 495, with 123 illustrations. 1937. Philadelphia and London: W. B. Saunders Co. 25s. net.

WE can strongly recommend this well-written and thoroughly practical work to all who undertake the preparation and after-care of "operation cases". The author has been assisted by twelve of his colleagues, who have each made a special study of certain aspects of the title-subject, so that the entire field of operative surgical enterprise is thus covered by experts. Everywhere stress is rightly laid upon the importance of co-operation with the physician in any case presenting features of complication, and especially in diabetes and in hyperthyroidism.

The value of blood transfusion is prominently emphasized, while the indications therefor and the various techniques are described in detail, though no mention is made of the use of 'defibrinated' blood, nor of the Russian method of utilizing 'corpse' blood.

An excellent chapter is that dealing with post-operative pulmonary complications, by Dr. Douglas S. King, who, at the request of the surgeons of the Massachusetts General Hospital, undertook a personal observation of the condition of the lungs after all the laparotomies and herniorrhaphies performed there during 1930 and 1931. More than 90 per cent of the complications therein discovered were due to "collapse or atelectasis" i.e., to a mechanical rather than an infective process. Of the highest practical value are the two chapters upon the urinary tract by Dr. George C. Prather, and the treatment of every conceivable complication is most concisely and efficiently described. Renal calculi are stated to recur after operative removal in from 10 to 15 per cent of cases: prophylactic measures are detailed and special stress is laid upon a suitable dietary, specimen menus being tabulated. It is pointed out that renal calculus is often the only evidence of hyperparathyroidism, and an estimation of the blood-content of calcium and phosphorus is therefore important in all cases. It is of interest to note that in strangulated hernia any attempt at taxis is condemned, as also is the stretching of the sphincter ani as a preliminary to rectal operations.

In the bibliography are 339 references to published work, the vast majority being concerned with American literature. The continent of Europe is represented by only 9 German, 5 French, and 1 Austrian mention—a quite inadequate recognition of the important contributions from foreign sources.

Recent Advances in Orthopædic Surgery. By B. H. BURNS, B.A., B.Ch., F.R.C.S., Orthopædic Surgeon to St. George's Hospital, etc., and V. H. ELLIS, M.A., B.Ch., F.R.C.S., Orthopædic Surgeon to St. Mary's Hospital, etc. Large post 8vo. Pp. 296 + viii, with 108 illustrations. 1937. London: J. & A. Churchill Ltd. 15s. net.

IN considering a book with a title such as this, one sometimes wonders how much is really new and whether any particular item is really an advance. This book gives an excellent description of much of the development that is taking place in orthopædic surgery and deserves to be read by all orthopædic surgeons, but it should be studied in a critical spirit because there is much in it that will not gain universal agreement and a good deal that is coloured by the opinions of the authors. The references given are not by any means complete, and it is rather notable that many important papers that have appeared in this JOURNAL are omitted. This is rather specially remarkable in the section on Hyperparathyroidism.

A good attempt has been made to write up the recent developments in the knowledge of bone growth, but this seems to have been a little beyond the powers of the two surgeons. The inter-reaction of serum calcium and plasma-phosphorus is not made clear, and on one page it is stated that the latter is low in rickets but two pages later is made to be high. Under Coxa Vara the statement is made that until quite recently the orthodox treatment consisted

in forcible reduction of the deformity by wide abduction of the affected hip under anæsthesia, attention then being called to the stiff joints that may result. This risk was first pointed out exactly thirty years ago and has been re-discovered on several occasions since by orthopædic surgeons who have imagined that they have found a new treatment. This is one of the risks incurred when an author or authors attempt to write up new methods. They are so often unaware that these methods have come into fashion and been abandoned on one or more occasions in the past. However, as already stated, this book will well repay the reader, provided that he is somewhat critical.

Source Book of Orthopædics. By EDGAR M. BICK, M.A., M.D., Adjunct Orthopædic Surgeon, Hospital for Joint Diseases and Mt. Sinai Hospital. 9 × 6 in. Pp. 376 + xv. 1937. Baltimore: The Williams & Wilkins Co. (London: Ballière, Tindall & Cox.) 15s.

IN many respects this book is a most creditable achievement. It is full almost to overflowing with information covering both the historical aspects of the evolution of orthopædic surgery and the contemporary practice of this speciality. It is obvious that the evaluation of a vast number of contributions to orthopædic literature, ranging over a period of centuries, demands powers of judgement and literary skill possessed by the very few.

If the author has failed to create a "Wellsian" classic, it is because the task has been too much for him. In such a work, inaccuracy of detail is almost inevitable, and there are many statements which call for correction or challenge. Notwithstanding, the work will, for a time at least, serve as a useful guide book to orthopædic literature.

Handbook of Orthopædic Surgery. By ALFRED RIVES SHANDS, jun., B.A., M.D., Associate Professor of Surgery in charge of Orthopædic Surgery, Duke University School of Medicine; in collaboration with RICHARD BEVERLY RANEY, B.A., M.D., Instructor in Orthopædic Surgery, Duke University School of Medicine. 9¼ × 6 in. Pp. 593, with 169 illustrations. 1937. London: Henry Kimpton. 21s. net.

ALTHOUGH this book appears under the names of two authors only, it really represents the composite work of over thirty American orthopædic surgeons. Every part of the text has been submitted for criticism and revision to more than one authority on the subject, so that the book is as fair a representation of the views of the American orthopædic profession as it is possible to obtain. In order to limit the size of the work, certain subjects, e.g., the treatment of recent fractures, plaster technique, orthopædic appliances, and obsolete methods, have been omitted. A bibliography of 58 pages is given in which all important English and American papers are included. The figures are very clear and well chosen, the majority being from pen-and-ink drawings. No photographs or X-ray pictures are used, but drawings from these have been used to illustrate characteristic features.

We can sincerely congratulate the authors on having succeeded in producing one of the simplest and clearest expositions of the subject which has yet appeared. The drawings of operative procedures, e.g., that of the shelf operation for congenital dislocation of the hip, are very clear and artistic and we wish that there were more of them. We are not quite satisfied that some well-chosen radiographs would not have been better than the sketches made from these. The book is of great value to students and practitioners.

Fratturati in Pace e in Guerra. By V. PUTTI. Cr. 8vo. Pp. 111, with 5 illustrations. 1936. Bologna: Licinio Cappelli.

THIS little book consists of two lectures given to Italian medical societies—in 1934 in Brescia, and in 1936 in Florence—on the treatment of civilian and war fractures respectively. Although the author makes his plea particularly for organization, he ends his first lecture by pointing out that this includes *specialization*, unpopular as that term is, and now that governments have recognized the necessity for specialization in medicine, the profession itself can no longer hang back. The book is of great interest at a moment when the medical profession and Government in Britain are both concerned with the subject of organizing the treatment of injuries. One would like every word of the author's to be read and re-read by those who have not yet realized the urgency and complexity of the problem. It is depressing to read

that, although he was intimately concerned with the organization of the military medical services in Italy during the Great War, yet he finds that his country has failed to apply to civilian practice the lessons learned at that time, which is the more surprising in view of the intensive organization of other phases of life in Italy.

Alike for civil and military practice, he says that the right policy is *evacuation*, after primary splinting (modifications of the Thomas leg and arm splint being advised), the distance travelled being unimportant; but no interference should be allowed until the *specialist centre* is reached, where treatment should be continued under *single control* until healing is attained. Exceptions to this rule naturally occur with gas gangrene and tetanus. He also advises a mobile orthopædic unit with special equipment to provide specialist treatment near the scene of injury for exceptionally complicated cases.

Primary suture of compound fractures is, in the author's opinion, only suitable for the exceptional case; while plating is entirely condemned, and lavage of wounds considered inferior to efficient rest.

Finally, as regards the teaching of medical students: this can never be satisfactory until accidents are segregated in large numbers under specially experienced surgeons.

Medical Urology. By IRVIN S. KOLL, B.S., M.D., F.A.C.S., Attending Urologist, Michael Reese Hospital, Chicago, Ill. 9½ × 6¼. Pp. 431, with 92 text illustrations and 6 coloured plates. 1937. London: Henry Kimpton. 21s. net.

THE author states in his preface that this book is intended to be of practical value to the general physician and medical student. It is well printed and contains many illustrations, and, we imagine, embodies the teaching of its author. We doubt whether it would make much appeal to the readers of this JOURNAL, for the information set forth therein seems to us rather superficial. It can hardly lay claim to be up to date, for in a rather extensive bibliography of three pages dealing with bladder infections there is no reference to any work done since the Great War. We note with surprise that a transatlantic cystoscopic field can include not only a large growth of the bladder but both ureteric orifices.

Urological Roentgenology. By MILEY B. WESSON, M.D., Ex-President, American Urological Association, and HOWARD E. RUGGLES, M.D., Roentgenologist to University of California Hospital, St. Luke's Hospital, and Clinical Professor of Roentgenology, University of California Medical School. 6¼ × 9¼ in. Pp. 269, with 227 illustrations. 1936. London: Henry Kimpton. 22s. 6d. net.

THIS book, which owes its inception to the inspiration of Dr. Howard A. Kelly, is a praiseworthy attempt to help the physician (*anglice*: the general practitioner) to interpret the complexities of modern radiographs of the urinary tract.

It is published in a handy form, is well printed, clearly written, and abundantly illustrated; the reproductions of the X-ray films are above the average, though we note with concern that the transatlantic radiographer has not yet acquired that valuable reflex—the marking of the film with a small sign to denote the side.

Two subjects will be of particular interest to British surgeons; neither of them has, in our experience, been widely discussed in the current urological literature. The first deals with the relation of renal ptosis and the Workmen's Compensation Insurance; in the States this condition is often attributed to slight injury or strain for which the worker receives compensation. To quote the authors: "Due to such rulings, it is becoming increasingly difficult for a workman to have a pyelogram made and avoid an operation at the expense of the insurance carrier. He is generally told either that his kidneys move too much and he needs a nephropexy to cure the ptosis, or they do not move enough and a nephrolysis is necessary to correct the perinephritis."

The second concerns the pathology of that rare condition, chyluria; the authors assume that, if there be a path by which the chyle from the thoracic duct can find its way to the urinary tract, retrograde gravity pyelograms should be able to demonstrate its existence. They present films of two cases which are entirely convincing, and have the added interest of being, in our opinion, unique.

We own to a sharp mental shock when we were informed that all aneurysms of the aorta were attributed to trauma before the advent of the Wassermann reaction; we can only

suggest a study of the life and works of John Hunter before this error is perpetuated in a second edition. Such dogmatic mis-statements shake the reader's faith, not in the authors' bona fides, but in the extent of their study of medical literature. An even more glaring example of an unfortunate generalization is their assertion that there are no characteristic findings in pyelograms of echinococcus cysts of the kidney; this could have been rectified without any deep knowledge of medical history. A superficial reading of recent numbers of this JOURNAL would surely have convinced them that the exact opposite is the truth.

In spite of these defects we recommend this work to our readers, for it shows evidence of much labour and contains some valuable prints of pyelograms of quite exceptional interest.

Lomboartrite e Sciatica Vertebrale. By V. PUTTI. Large royal 8vo. Pp. 218, with 144 illustrations, some coloured. 1936. Bologna: Licinio Cappelli.

THIS book of 218 pages, generously illustrated with excellent photos and radiographs, is a clinical study of extreme value. Like every product of Professor Putti's pen, it represents a vast amount of original investigation of a big material, carried out with meticulous thoroughness in wards, operating theatre, research laboratory, and X-ray department. It is to be hoped that it will be made available in other languages within a reasonable time. But even for those who are not Italian scholars, the clear illustrations are themselves worthy of study.

Professor Putti's views in regard to sciatica are already widely known—namely, that in the majority of cases the site of irritation is the vertebral canal secondary to arthritis of the posterior spinal joints, rather than the peripheral nerve-trunk, as is still commonly thought by a large number of practitioners. In this book much interesting evidence, both anatomical and clinical, is brought forward in support of the writer's thesis. As he points out, one has no right to exclude arthritis for lack of X-ray evidence, unless one has available absolutely first-class radiographs, and while these are becoming more common, they are not by any means universal yet. Even with the best, one must not forget the fact, common to arthritis in any joint, that it is only rather late stages that give X-ray evidence of their presence. If this is true of superficial joints like the knee, how much more so of the deep spinal joints, for which even good radiographs demand special experience in interpretation. Attention is drawn to the value of flexing the hips when X-raying a lumbar spine, which is in spasm and so lordotic, with consequent varying distances of its joints from the film.

Prof. Putti regards the term "simple sciatica" as one of the happy refuges of the general practitioner, otherwise non-existent! He devotes a chapter to contradicting on anatomical grounds Sicard's conception of funiculitis, as he reminds us that the posterior root ganglion lies partly in the bony canal and is intradural, so that it also may be involved by any lesion which reduces the volume of the canal. Another chapter is devoted to discussing the extent to which congenital abnormalities, like sacralization of the 5th lumbar vertebra, may play their part in the production of sciatica. Like many of the American observers, who first drew attention to the frequency of these abnormalities, he also finds that, while they may predispose to early arthritis, they are not in themselves, when uncomplicated, a cause of sciatica.

Successive chapters deal with the pathology, anatomy, and X-ray diagnosis of arthritis of the posterior spinal joints. Two long sections discuss respectively the clinical diagnosis of sciatica and its treatment. It is impossible to refer to all the interesting points which the author brings forward. He stresses the value of a careful history of the onset and character of the pain, which in lumbar arthritis is ill localized and was only associated with objective sensory changes in under 3 per cent amongst 1100 cases. In only 14 cases out of this series was there definite paralysis, though considerable wasting of muscles was common. The author considers this complication to be of bad prognosis, and, though the initial weakness did not spread, improvement was slow and was incomplete in all but 2 cases. The reflexes he does not consider to be of diagnostic value, as the loss of the ankle-jerk merely implies weakness of the calf muscles, while exaggeration of the knee-jerk represents slight weakness of the hamstrings.

A good deal of space and some interesting photos are devoted to the association of scoliosis with sciatica, which it is said occurred in 86 per cent of the cases, a phenomenon to be expected, as the deformity represents that protective muscular spasm which is present in nearly all forms of arthritis. The heterolateral curve, i.e., deviation of the trunk away from the affected side,

was found in 43 per cent, but these cases did not show such striking X-ray changes as the homolateral type. It has to be remembered that a unilateral curve does not prove the existence of unilateral arthritis, for the common condition is bilateral disease with one side in a more irritable condition than the other; and as already remarked, changes visible in X rays are those of the late, chronic stage.

In regard to differential diagnosis, the author reminds us that sciatica is a common early symptom of tuberculosis of the spine and sacro-iliac joints, sometimes occurring before X-ray evidence of the disease is available. The same is true of secondary malignant growths in the vertebræ. Again, with 'spondylosis' (spondylitis ankylopoietica) there may be little X-ray change till the disease is advanced as regards deformity. Another lesion, which may even cause the paralytic type of sciatica, is osteochondritis with hernia of the intervertebral disc, of which Schmorl gathered such interesting specimens.

Finally, in dealing with treatment the author groups the remedies into three types: (1) Drugs of the salicylate group, whose value is still the subject of dispute. (2) Heat in all its various forms, which has most valuable effects in all forms of arthritis and not less so in the lumbar form. In spite of all the elaborate and expensive forms of electric heat bath and diathermy apparatus which have been put on the market during these latter years, the author considers that they benefit the pockets of manufacturer and practitioner more than the patient's back, and that none can compare in efficacy with the original Bier's box, heated by a current of air from a spirit lamp; for it provides a moving current of air, slightly moistened, and it can be regulated from 90°, at which the early treatments should be given, to 130°, which later can be borne for periods up to forty minutes. (3) Rest is the third and not least valuable method of treatment, which the author recommends most in the form of a closely-fitting plaster corset, often followed by a removable one reinforced with steels. He also discusses in detail arthrodesis and other operative methods.

Altogether this book is likely to improve the investigation and treatment of an unfortunate set of patients who have suffered much in the past at the hands of quacks, both in and out of the profession.

Infantile Paralysis and Cerebral Diplegia. Methods used for the Restoration of Function. By ELIZABETH KENNY. With a Foreward by HERBERT J. WILKINSON, Professor of Anatomy and Dean of the Faculty of Medicine, University of Queensland. Demy 8vo. Pp. 125 + xxxviii, with numerous plates. Sydney: Angus & Robertson Ltd. 21s.

MISS KENNY'S methods have given rise to a great deal of discussion in Australia and more recently in this country. Briefly stated, she believes that in infantile paralysis there is a much more complete potentiality of recovery than is generally recognized. She advocates the commencement of physical treatment as soon as the pyrexial period is over; the use of hot and cold douches to stimulate circulation, passive movements of all joints from the first, and active exercises, and more particularly exercises in a bath, as soon as they can be carried out. She also maintains that splinting is undesirable and unnecessary and that appliances are not required, but it is notable that she makes use of a good deal of mechanical equipment to prevent or correct deformity. So far as actual methods of re-education are concerned, these do not differ essentially from those carried out in Swedish remedial work or from those advocated by Sir Colin Mackenzie. Her treatment of cerebral diplegia really follows orthodox lines of training in relaxation and re-education.

Wesen, Erkennung und Behandlung der Krebskrankheit. By Geh.-Rat Prof. Dr. FRITZ KÖNIG, Würzburg, and Prof. Dr. ERNST SEIFERT, Würzburg. Bd. 57 of *Neue Deutsche Chirurgie* (Lexer). 10½ × 7⅛. Pp. 300 + viii, with 29 illustrations and 1 graph. 1937. Stuttgart: Ferdinand Enke. RM 25.70; bound, RM 27.70.

THIS book is in two parts, by different authors, and is lacking in order, completeness, and conciseness. The first part by Prof. Fritz König is concerned with the diagnosis and treatment of cancer and precancerous conditions, but the subject is treated without any adequate presentation of the pathological foundations upon which surgical treatment must be based. The general conception that cancer is in origin a local disease seems to be accepted as a sufficient pathological guide to surgical treatment. It is stated in the preface that foreign literature of value is included in the bibliography, but among a list of about eighty papers

on breast cancer, only six American references occur, and no English ones. May it perhaps be inferred that scientific as well as economic nationalism is a German policy? A figure on p. 55 suggests that the surgery of breast cancer in Germany still belongs to the era which in this country preceded the work of Stiles, Cheyne, and Handley.

The second part of the book by Prof. Ernst Seifert deals with the special treatment of cancers in different districts of the body, and also with electrosurgery, with radiotherapy, and with the operative results of the Würzburg clinic. "Long-winded descriptions of school-operations are avoided." In this part of the book also the descriptions are too vague and general and too much divorced from pathological considerations to be really helpful, at any rate to an English reader, especially as the illustrations are few. But a critical perusal of the book will prove interesting and profitable to those who are expert in the German language, for it undoubtedly represents the results of its authors' extensive experience, and of their wide knowledge of German literature.

BOOK NOTICES

[The Editorial Committee acknowledge with thanks the receipt of the following volumes. A selection will be made from these for review, precedence being given to new books and to those having the greatest interest for our readers.]

The Abdominal Surgery of Children. By Sir LANCELOT BARRINGTON-WARD, K.C.V.O., Ch.M., F.R.C.S. (Eng. and Edin.), Surgeon to H.M. The King; Senior Surgeon, Hospital for Sick Children, Great Ormond Street; Senior Surgeon, Royal Northern Hospital, London. Second edition. Demy 8vo. Pp. 333 + xv, with 97 illustrations and 4 coloured plates. 1937. London: Oxford University Press. 25s. net.

Scritta di Chirurgia erniaria. In commemoration of the fiftieth anniversary of Bassini's operation. Collected and edited by G. M. FASIANI and A. CATTERINA. In two volumes. 9½ × 7¼ in. Pp. 1172, with several illustrations. 1937. Padua: Tipografia del Seminario di Padova.

Mecanismo probable de la Cancerización. By AMÉRICO GARIBALDI. In two volumes. 10 × 7 in. Pp. 608 + xxxii, with illustrations. 1936. Lima (Peru): Facultad de Ciencias medicas, Universidad Mayor de San Marcos.

Die Behandlung der bösartigen Geschwülste der Mundhöhle. By Priv. Doz. Dr. OTTO SCHÜRCH, Zurich. Heft 15 of *Vorträge aus der praktischen Chirurgie* (Lexer). Large royal 8vo. Pp. 44. 1936. Stuttgart: Ferdinand Enke. Paper covers, RM. 2.60.

Short-wave Diathermy. By TIBOR DE CHOLNOKY, Associate in Surgery, New York Post-graduate Medical School, Columbia University. 9¼ × 6¼ in. Pp. 310 + xvi, with 38 illustrations. 1937. New York: Columbia University Press. (London: Humphrey Milford, Oxford University Press.) 20s. net.

The Technic of Local Anæsthesia. By ARTHUR E. HERTZLER, A.M., M.D., F.A.C.S., Professor of Surgery in the University of Kansas; Surgeon to the Halstead Hospital; etc. Sixth edition. Large royal 8vo. Pp. 284, with 142 illustrations. 1937. London: Henry Kimpton. 21s. net.

Tumours of the Nervous System. An Investigation of the most Recent Advances. Being The Proceedings of the Association for Research in Nervous and Mental Disease, New York, December 27 and 28, 1935. 9¼ × 6 in. Pp. 493 + xxii, with 213 illustrations. 1937. Baltimore: Williams & Wilkins Co. (London: Baillière, Tindall & Cox.) 34s. net.

Gastroscopy: The Endoscopic Study of Gastric Pathology. By Dr. RUDOLF SCHINDLER, Associate Clinical Professor of Medicine, University of Chicago. With a Preface by Dr. WALTER LINCOLN PALMER, Associate Professor of Medicine, University of Chicago. 9½ × 6¾. Pp. 343 + xiii, with 89 text figures and 8 coloured plates. 1937. Chicago: University of Chicago Press. (London: Cambridge University Press.) 34s. net.

Operative Surgery. By Dr. MARTIN KIRSCHNER, Tübingen, with the collaboration of A. LAUTENSCHLÄGER, Berlin, and Dr. O. KLEINSCHMIDT, Wiesbaden. Volume III. The Ear, Air Passages and Neck. Authorized translation by I. S. RAVDIN and GEORGE M. COATES. 10½ × 7 in. Pp. 528 + xiii, with 460 illustrations, mostly coloured. 1937. Philadelphia and London: J. B. Lippincott Co. 50s. net.

Surgical Treatment. A Practical Treatise on the Therapy of Surgical Diseases. By JAMES PETER WARBASSE, M.D., F.A.C.S., Special Lecturer in the Long Island Medical College, and CALVIN MASON SMYTH, jun., B.S., M.D., F.A.C.S., Assistant Professor of Surgery in the University of Pennsylvania Graduate School of Medicine. Second edition. 9½ × 6¼ in. In three volumes, and an index volume. Pp. 2486, with 2237 illustrations. 1937. London: W. B. Saunders Co. Ltd. £7 7s. net.

Surgery of the Sympathetic Nervous System. By GEORGE E. GASK, C.M.G., D.S.O., F.R.C.S. Eng., Emeritus Professor of Surgery, University of London; Consulting Surgeon, St. Bartholomew's Hospital; and T. PATERSON ROSS, M.S. Lond., F.R.C.S. Eng., Professor of Surgery, University of London; Surgeon and Director of the Surgical Unit, St. Bartholomew's Hospital. Second edition. Large royal 8vo. Pp. 186 + xii, with Frontispiece and 49 illustrations. 1937. London: Baillière, Tindall & Cox. 16s.

Illustrations of Regional Anatomy. By E. B. JAMIESON, M.D., Senior Demonstrator and Lecturer, Anatomy Department, University of Edinburgh. Second edition. F'cp. 4to. Section I, Central Nervous System, 48 Plates, 7s. Section II, Head and Neck, 63 Plates, 12s. 6d. Section III, Abdomen, 37 Plates, 5s. 6d. Section IV, Pelvis, 33 Plates, 3s. 6d. Section V, Thorax, 30 Plates, 4s. 1936. Edinburgh: E. & S. Livingstone.

Surgical Nursing. By HUGH CABOT, M.D., F.A.C.S., Senior Consultant, Mayo Clinic, Rochester, Minn.; and MARY DODD GILES, R.N., A.M., Associate Professor of Nursing Education, Vanderbilt University. Third edition. Large post 8vo. Pp. 441, with 121 illustrations. 1937. London: W. B. Saunders Co. Ltd. 13s. net.

Sportschäden und Sportverletzungen. By Prof. Dr. BURGHARD BREITNER, Innsbruck. Bd. 58 of *Neue Deutsche Chirurgie* (Lexer). 10¼ × 7 in. Pp. 174 + viii, with 39 illustrations. 1937. Stuttgart: Ferdinand Enke. RM. 14; bound, RM. 16.

A Surgeon's Pocket Book. By H. S. SOUTTAR, D.M., M.Ch. (Oxon.), F.R.C.S. (Eng.), Surgeon, London Hospital. Second edition. F'cap 8vo. Pp. 285 + viii, with 24 plates. 1937. London: William Heinemann (Medical Books) Ltd. 7s. 6d. net.

Tissue Reactions in Bone and Dentine. A Morpho-biological Study of the Formation and the Dissolving of Bone and Dentine. By ÅKE WILTON, M.D., Associate Professor and Lecturer in Pathology at the Caroline Institute, Stockholm. 9 × 6 in. Pp. 194, with 64 illustrations. 1937. London: Henry Kimpton. 15s. net.

A Text-book of Ophthalmic Operations. By HAROLD GRIMSDALE, M.B., F.R.C.S., Consulting Ophthalmic Surgeon to St. George's Hospital; Consulting Surgeon to the Royal Westminster Ophthalmic Hospital; and ELMORE BREWERTON, F.R.C.S., Consulting Ophthalmic Surgeon to the Metropolitan Hospital; Consulting Surgeon to the Royal Westminster Ophthalmic Hospital. Third edition. 9 × 6¼ in. Pp. 322 + ix, with 105 illustrations. 1937. London: Baillière, Tindall & Cox. 17s. 6d. net.

Thoracic Surgery. By FERDINAND SAUERBRUCH, Professor of Surgery in the University of Berlin, and LAURENCE O'SHAUGHNESSY, F.R.C.S., Hunterian Professor in the Royal College of Surgeons of England. A revised and abridged edition of Sauerbruch's *Die Chirurgie der Brustorgane*. Imp. 8vo. Pp. 394 + viii, with 215 illustrations and 16 coloured plates. 1937. London: Edward Arnold & Co. 50s. net.

The Science and Practice of Surgery. By W. H. C. ROMANIS, M.A., M.B., M.Ch. Cantab., F.R.C.S. Eng., F.R.C.S. Edin., Surgeon and Lecturer on Surgery, St. Thomas's Hospital, etc.; and PHILIP H. MITCHINER, M.D., M.S.(Lond.), F.R.C.S.(Eng.), Hon. Surgeon to H.M. The King; Hunterian Professor, Royal College of Surgeons of England; Surgeon and Lecturer in Surgery, St. Thomas's Hospital, etc. Sixth edition. 9¾ × 6¾ in. Vol. I, General Surgery. Pp. 808 + Index, with 393 illustrations and 13 plates. Vol. II, Regional Surgery. Pp. 978 + Index, with 337 illustrations and 6 plates. 1937. London: J. & A. Churchill Ltd. 14s. net each volume.

Post-graduate Surgery. Edited by Rodney Maingot, F.R.C.S. In three volumes. Royal 8vo. Vol. III. Pp. 3573–5584, with 994 illustrations. 1937. London: Medical Publications Ltd. £9 9s. the set, or £3 10s. per volume.

Life and Death. The Autobiography of a Surgeon. By ANDREA MAJOCCHI, Professor of Surgery, Milan. Translated by H. J. STENNING. Demy 8vo. Pp. 343. 1937. London: George Allen & Unwin Ltd. 10s. 6d.

St. Bartholomew's Hospital Reports. Edited by G. EVANS, G. GRAHAM, G. HADFIELD, C. F. HARRIS, W. SHAW, A. WORMALL, W. G. BALL, J. P. ROSS, and J. MAXWELL. Vol. LXX. Demy 8vo. Pp. 381 + xxviii. Illustrated. 1937. London: John Murray. 21s. net.